

INSTRUCTION MANUAL

MODEL L-7455 DIODE ARRAY DETECTOR

Read and keep this manual.

- Read safety instructions carefully and understand them before starting your operation.
- Keep this manual at hand for reference.

HITACHI

INSTRUCTION MANUAL

FOR

L-7455 DIODE ARRAY DETECTOR

5th Edition, February 2000
1st Edition, 1998

Part No. 810-9371-4 TT-TH (HTT-LT)

PREFACE

Thank you very much for purchasing Hitachi Model L-7455 diode array detector. The Model L-7455 is designed for carrying out multi-wavelength absorbance detection in the liquid chromatograph system. The Model L-7455 is intended for use by persons having a basic knowledge of chemical analysis. Remember that improper use of the analytical instruments, chemicals or samples would result not only in wrong analytical data but also in consequences adverse to safety.

Read this instruction manual carefully before attempting operation. For proper use of this instrument, please acquaint yourself with it.

ABOUT THIS MANUAL

This instruction manual has been prepared for users of the Model L-7455. The operation, checkup and maintenance procedures are contained herein.

First of all, be sure to read 'IMPORTANT' and 'SAFETY SUMMARY' at the beginning of this manual.

In case that the instrument is not yet installed, refer to Section 2. When using the instrument at the first time, read through Sections 3 and 4 to acquire an understanding of the instrument configuration and basic operational procedure.

IMPORTANT

Precautions on Electromagnetic Wave Interference

(1) Possible Electromagnetic Wave Interference by This Instrument

When this instrument is used in or adjacent to a residential area, it may cause interference to radio and television reception.

To prevent this, use the specified connecting cables in strict accordance with the instruction manual. The instrument is designed to provide reasonable protection against radio wave interference if the specified cables are connected properly. However, there is no guarantee that radio wave interference will not occur in a particular installation.

If the instrument does cause interference to radio or television reception, which can be determined by turning the instrument off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the radio/TV receiving antenna.
- Increase separation between the instrument and the radio/TV receiver.
- Connect the instrument to an outlet on a circuit different from that to which the radio/TV receiver is connected.

(2) Possible Radio Wave Interference to This Instrument

If this instrument is used near an intense electromagnetic source, however, interfering noise may be given to the instrument to cause an adverse effect on its performance or functionality.

To prevent this, use the specified connecting cables in strict accordance with the instruction manual. The instrument is designed to minimize electromagnetic wave interference to itself. However, there is no guarantee that electromagnetic wave interference will not occur in this instrument.

If the instrument does incur electromagnetic wave interference, which can be determined by turning off and on possible source(s) of electromagnetic interference nearby, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the instrument.
- Increase separation between the instrument and possible source(s) of electromagnetic interference.
- Connect the instrument to an outlet on a circuit different from that to which possible source(s) of electromagnetic interference are connected.
- Check that other devices connected with the instrument are not affected by electromagnetic interference.

Product Warranty

The L-7455 diode array detector is warranted to be free from defects in material, workmanship and operation under normal use within the product specifications indicated in this manual and under conditions given below.

(1) Scope of Warranty

Liability under this warranty is limited to repair of the instrument without charge due to defects in material or workmanship.

Note that a substitute part may be used for repair, or replacement with an equivalent product may be made instead of repair. Such system components as a personal computer and printer to be updated frequently for improvement may not be available in original versions at the time of replacement.

The warranty contained herein is for the benefit of and shall be enforceable by the original purchaser of this instrument and is not transferable.

Consumable parts and operating supplies are excluded from this warranty.

(2) Warranty Period

One year from the date of initial installation.

(3) Limitations and Exclusions on Warranty

Note that this warranty is void in the following cases:

- (a) Failure due to operation at a place not meeting the installation requirements specified by Hitachi.
- (b) Failure due to power supply voltage/frequency other than specified by Hitachi or due to abnormality in power supply.
- (c) Corrosion or deterioration of the tubing due to impurities contained in gas, air or cooling water supplied by the user.
- (d) Corrosion of the electric circuits or deterioration of the optical elements due to highly corrosive atmospheric gas.
- (e) Failure due to use of hardware, software or spare parts other than specified by Hitachi.
- (f) Failure due to improper handling or maintenance by user.
- (g) Failure due to maintenance or repair by a service agent not approved or authorized by Hitachi.
- (h) Failure due to relocation or transport after initial installation.
- (i) Failure due to disassembly, modification or relocation not approved by Hitachi.

- (j) Failure due to acts of God, including fire, earthquake, storm, flood, lightning, social disturbance, riot, crime, insurrection, war (declared or undeclared), radioactive pollution, contamination with harmful substance, etc.
- (k) Failure due to computer virus infection.

HITACHI MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, EXCEPT AS PROVIDED HEREIN, INCLUDING WITHOUT LIMITATION THEREOF, WARRANTIES AS TO MARKETABILITY, MERCHANTABILITY, FOR A PARTICULAR PURPOSE OR USE, OR AGAINST INFRINGEMENT OF ANY PATENT. IN NO EVENT SHALL HITACHI BE LIABLE FOR ANY DIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE, OR LOSSES OR EXPENSES RESULTING FROM ANY DEFECTIVE PRODUCT OR THE USE OF ANY PRODUCT.

NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY HITACHI, ITS DEALERS, DISTRIBUTORS, AGENTS OR EMPLOYEES SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY.

HITACHI ASSUMES NO LIABILITY FOR ANY DAMAGE TO DATA OR APPLICATION SOFTWARE DUE TO ANY POSSIBLE FAULT OR FAILURE OF THIS INSTRUMENT.

(4) Warranty Card

The separate warranty card may not be reissued. Keep it in a safe place.

Installation, Relocation and After-sale Technical Service

Installation of this instrument shall be carried out by or under supervision of qualified service personnel of Hitachi or its authorized service agent.

Before installation of this instrument, the customer shall make preparations for satisfying the installation requirements in accordance with this manual.

When relocation of this instrument becomes necessary after initial installation (delivery), please notify your local Hitachi sales representative or nearest Hitachi service office.

Other Precautions

(1) Handling of Chemicals and Samples

- (a) The user is responsible for following relevant legal standards and regulations in the handling, storage and discarding of chemicals and samples used in analytical operations of this instrument.
- (b) Reagents, standard solutions and accuracy-control samples shall be handled, stored and discarded as instructed by the respective suppliers.

(2) Notice on This Instruction Manual

- (a) The information contained in this manual is subject to change without notice for product improvement.
- (b) This manual is copyrighted by Hitachi with all rights reserved. No part of this manual may be reproduced or transmitted in any form or by any means without the express written permission of Hitachi.



SAFETY SUMMARY



General Safety Guidelines

Before using the L-7455 diode array detector, carefully read the safety instructions given below.

- Operate the instrument according to the instructions in this manual.
- Installation and maintenance of the instrument shall be referred to service personnel qualified by Hitachi.
- Be sure to observe the warnings indicated on the product and in the instruction manual. Failure to do so could result in personal injury or damage to the product.
- The hazard warnings which appear on the warning labels on the product or in the manual have one of the following alert headings consisting of an alert symbol and a signal word DANGER, WARNING or CAUTION.



DANGER : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING : Indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.



CAUTION : Indicates a hazardous situation which, if not avoided, will or can result in minor or moderate injury, or serious damage to the product.



: The alert symbol shown at left precedes every signal word or hazard warnings, and appears in safety-related descriptions in the manual.

NOTICE : Used to present warnings which are not directly related to personal injury hazards but concern the proper use of the product.



SAFETY SUMMARY



General Safety Guidelines (Continued)

- When using a chemical for analytical operation, be sure to provide proper ventilation of the laboratory room as per local requirements. Inadequate ventilation could endanger human health.
- Do not modify the instrument, replace parts that are not user-serviceable, use non-specified parts, nor remove safety devices, as it could be hazardous.
- Installation at delivery, maintenance and relocation shall be carried out by or under direction of service personnel qualified by Hitachi.
- Do not perform any operation or action other than described in this manual. When in doubt, please contact your local Hitachi sales representative or nearest Hitachi service office.
- Keep in mind that the hazard warnings in this manual or on the product cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand.
Be alert and use your common sense.



SAFETY SUMMARY



WARNING: Ignition of Flammable Chemicals!

Handling of Flammable Chemicals

- Beware of ignition hazard when using flammable chemicals such as organic solvents.
- Always check the following conditions. If an abnormality is found, stop operation immediately.
 - ◇ Leakage of solvent or waste solution
 - ◇ Leakage of solvent inside the instrument
- Be sure to adequately ventilate the laboratory room where the instrument is installed.
- This instrument is not explosion-proof. In unattended operation, do not use organic solvents having an ignition point below 70°C.
- When using flammable chemicals, be careful about possible ignition due to static electricity. Particularly when using non-conductive chemicals, employ a conductive vessel and provide proper grounding connection.



WARNING: Explosion of Vapor from Flammable Chemicals!

Handling of Flammable Chemicals

- If a flammable chemical such as organic solvent leaks from the flow path of the instrument and its vapor concentration exceeds the explosion limit, it may cause spontaneous combustion with dangerously explosive results.
- When using a flammable and readily volatile chemical, be sure to check for leakage from the instrument flow path and ventilate the laboratory room adequately.



SAFETY SUMMARY



WARNING: Electric Shock in Contact with Inside of Instrument!

Beware of Electric Shock.

Potentially Dangerous Voltages are Present within the Instrument.

- Before removing the instrument cover for replacement or adjustment of internal parts, be sure to turn off the power switch and unplug the power cord.
- Before removing the light source cover for replacement of the light source lamp in the L-7455 diode array detector, be sure turn off the power switch.
- In the L-7455 diode array detector, removal of the light source cover causes the safety mechanism to shut power off automatically. Never release the safety mechanism inadvertently.



WARNING: Electric Shock due to Improper Grounding!

Ground Properly to Prevent Electric Shock Hazard.

- Be sure to use the power cable supplied with the instrument. Use of a different power cable may result in an electric shock hazard.
- This instrument is classified as "plug-connected type" in the EN61010-1 Standards, so connect the power cable to a grounded three-wire outlet.
- If a grounded three-wire outlet is not available, use a plug adapter for connection with a two-wire outlet. In this case, be sure to provide proper grounding.



SAFETY SUMMARY

 **CAUTION: Touching Hot Part Could Result in Burns!**

Caution on Replacement of Light Source Lamp

- The light source lamp and the lamp chamber in the L-7455 diode array detector remain hot for a while even after power-off and can severely burn you if touched.
Before replacement of the light source lamp, turn power off and wait for about 30 minutes until it becomes sufficiently cool.

NOTICES:

Restriction on Use of Reagents

- Fluorocarbon resin and quartz crystal materials are used in the flow path in this instrument. Never use reagents that would corrode these materials.

Precautions on Use of Corrosive Solvents

- The drain path for carrying leakage solutions is made of polypropylene.
- The materials inside the instrument are susceptible to corrosion by strong acid, strong alkali and organic solvents.
- When using corrosive solvents, make sure that the tubing connections are not loose.
- Using the pump pressure limiter function or by other means, make setting so that liquid delivery is forced to stop automatically if leakage occurs.



SAFETY SUMMARY

Precautions on Disposal of Waste Solution

- Be sure to collect waste solution and treat it properly for disposal according to the relevant environmental protection regulations. Improper disposal treatment of waste solution may result in environmental pollution. Be sure to observe the law related to environmental protection.

Precaution on Accuracy/Precision of Measured Values

- Perform control sample measurements to ensure that the performance of the instrument is normal.

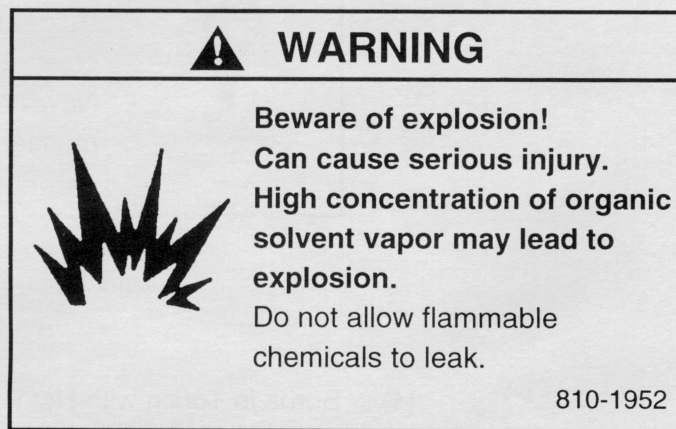


SAFETY SUMMARY

WARNING LABELS

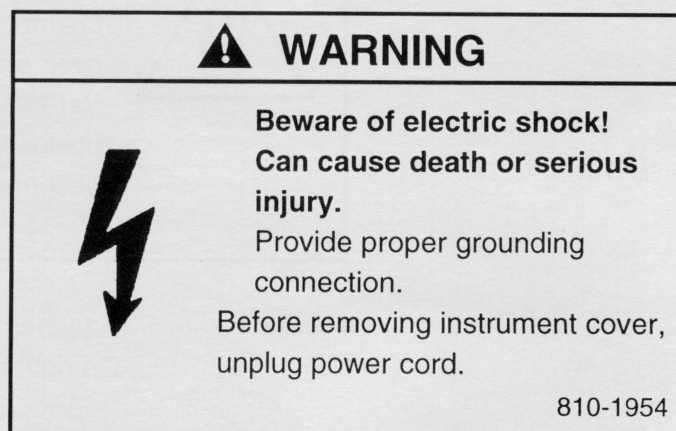
The warning labels shown below are attached on the L-7455 diode array detector.

- (1) Explosion of Vapor from Flammable Chemicals

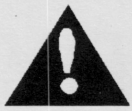


[Attached position]
On right rear side

- (2) Electric Shock in Contact with Inside of Instrument



[Attached position]
On left rear side





SAFETY SUMMARY

- (3) Electric Shock in Contact with Light Source Power Supply

 WARNING	
	<p>Beware of high voltage: 500 V. Can cause fatal or serious injury.</p> <p>Before removing light source cover, turn power switch off. Never release safety mechanism inadvertently.</p> <p>810-1958</p>

[Attached position]
On right rear side

- (4) Burns in Touch with Hot Part

 CAUTION	
	<p>Beware of high temperature! Can cause burns.</p> <p>Light source lamp and lamp chamber remain hot for a while even after power-off. Before lamp replacement, turn power off and wait until it becomes sufficiently cool.</p> <p>810-1962</p>

[Attached position]
On right rear side

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1. OUTLINE

The L-7455 is a liquid chromatography detector which uses a 512-bit photodiode array as a detecting element. It features a high wavelength resolution and sensitivity in the UV region due to an optical system which utilizes a prism as a light dispersing element. Since 3-dimensional chromatogram data is obtainable in a wavelength range of 190 to 800 nm, the following kinds of chromatograms can be displayed through combination with the D-7000 HPLC system manager:

- Contour line chromatograms
- Three-dimensional chromatograms
- Best chromatograms
- Smoothed chromatograms
- Baseline corrected chromatograms
- Multi-chromatograms

Also, the provision of the special calculation function for the D-7000 HPLC system manager enables carrying out peak purity check, peak component identification, and creation/retrieval of spectral library data automatically.

In this manual, the L-7455 Diode Array Detector is referred to as L-7455 DAD. For the handling of units other than the L-7455 DAD, refer to the instruction manuals provided with them.

NOTICE:	This instrument is compatible with version 3.1 of the D-7000 advanced HPLC system manager/D-7000 advanced multi-system manager (just referred to as the D-7000 HPLC system manager in this manual). Note that this instrument is not compatible with a version earlier than 3.1.
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2. INSTALLATION

2.1 DAD Installation



CAUTION

This unit is heavy.

The detector weighs 16 kg, and could cause injury if dropped. Hold it firmly by the front and rear and handle carefully when transporting.

NOTICE: Installation at delivery will be carried out by, or under the instructions of, our installation engineers or Hitachi-approved specialists. The customer is responsible for preparing the necessary conditions for installation in accordance with this manual. If relocation becomes necessary after the initial installation, be sure to consult the dealer from whom you bought the detector or Hitachi's nearest service representative, in order to avoid possible troubles.

2.1.1 Unpacking

Unpack and take out the detector and accessories carefully so as not to apply shocks, and place them on a sturdy and level table.

2.1.2 Check of Delivered Items

When unpacking is finished, check the quantities of delivered items against the furnished packing list.

2.1.3 Installation Conditions

Make sure the following conditions are satisfied for installing the detector.

- (1) Power supply voltage...100 to 240 V AC

Variation should be within $\pm 10\%$ of rated voltage.

- (2) Frequency...50 or 60 Hz

Variation should be within ± 0.5 Hz of rated frequency.

2.1 DAD Installation

(3) Power capacity...200 VA or more

This capacity is required for the L-7455 DAD alone. A power source of sufficient margin should be prepared in consideration of use with other units.

(4) Ground terminal

A ground terminal with grounding resistance of 100 ohms or less should be provided within 3 meters of the instrument.

Grounding resistance 100 Ω or less

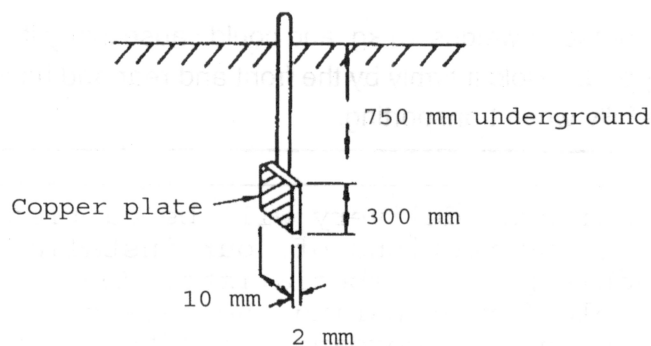


Fig. 2-1 Grounding Means

2.1.4 Place of Installation

The L-7455 DAD main unit requires a space of at least 450 mm wide by 650 mm deep. Although dependent on the combination of units, a sturdy table or the like measuring 1200 × 700 mm is needed for using the L-7100 pump, L-7455 DAD and D-7000 HPLC system manager. And a space of at least 150 mm must be left at the rear of the instrument.

2.1.5 Installation Environment

NOTICE: Be careful that air from an airconditioner or the like does not strike the detector directly. This would cause an unstable baseline or drop in reproducibility.

The following conditions must be satisfied at the installation site.

- (1) Operating temperature range within 15 to 35°C, and a minimum of temperature fluctuation during measurement. Although use is possible in a range of 4 to 15°C, be careful that condensation does not form.
- (2) Operating humidity range from 45 to 85%
- (3) Atmospheric Gas
 - (a) There must be sufficient ventilation.
 - (b) Acidic or alkaline gas that would corrode metal must not be present.
 - (c) Gas from organic solvent (especially benzene or thinner) that would dissolve paint must not be present.
- (4) Other Conditions to be Avoided
 - (a) Direct sunlight. This would affect performance and cause discoloration of the instrument. Avoid installing near a window.
 - (b) Direct exposure to drafts
 - (c) Vibration or shocks perceptible to the human body.
 - (d) Location near heat radiating objects such as gas burner, electric heater or oven.
 - (e) Location near equipment generating a strong magnetic field (such as electric welder, high frequency electric furnace, pole transformer, etc.).
 - (f) Dusty location. This would affect performance.
 - (g) Power voltage apt to fluctuate abruptly. This would become a noise source.
 - (h) Frequent ON-OFF of power supply for motor (stirrer, vibrator, etc.) not having a noise preventing means that is connected to the same power line as this instrument.

2.2 Removal of Transport Screws, Sponge and Flow Cell Retaining Part

2.2 Removal of Transport Screws, Sponge and Flow Cell Retaining Part

NOTICE: For installation of the L-7455 DAD, be sure to remove the transport screws at the instrument bottom, the transport sponge located inside the detector, and the flow cell retaining part.

- (1) There are two transport screws at the instrument bottom. Remove them using a Phillips screwdriver.

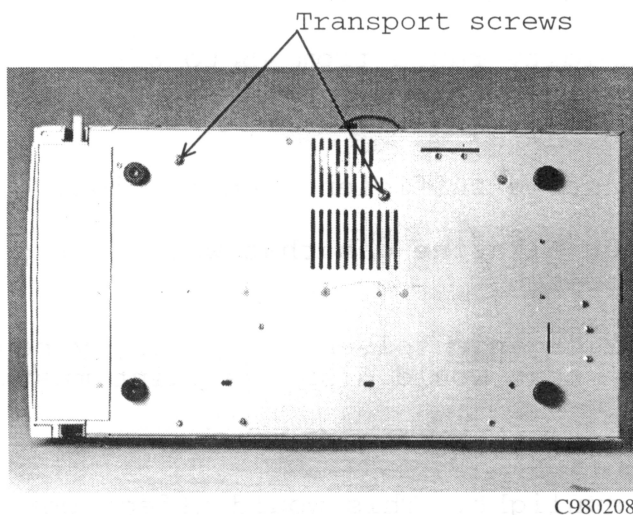


Fig. 2-2 Removal of Transport Screws

- (2) The transport sponge is located inside the detector. Remove the light source cover on the right side of the instrument, remove the top lid of the detector, and then take out the transport sponge (1 pc) from the inside of the detector.

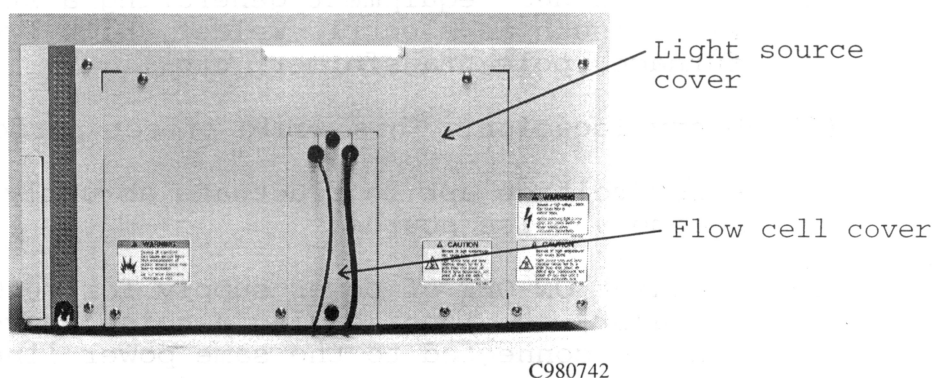


Fig. 2-3 Side of Unit

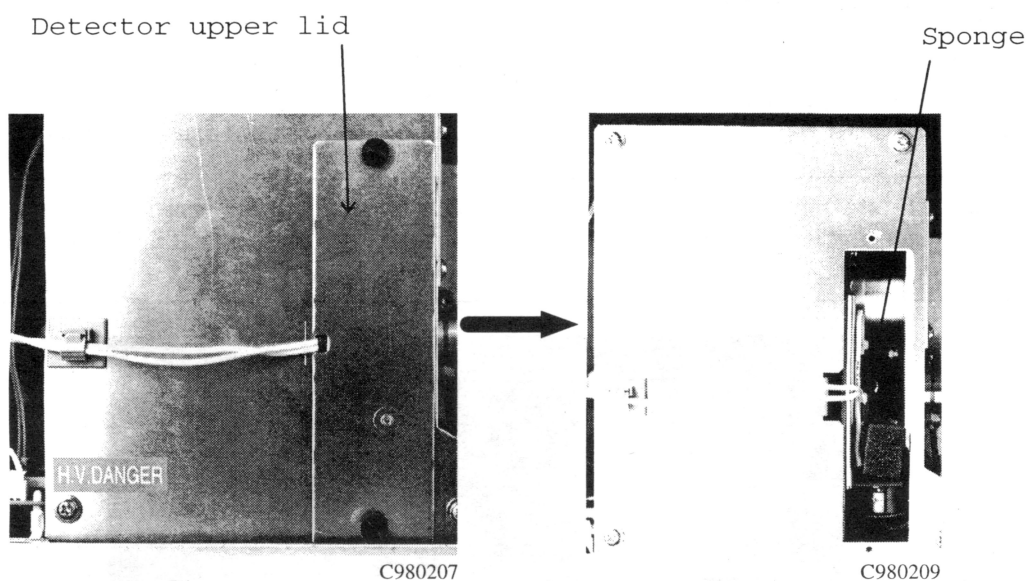
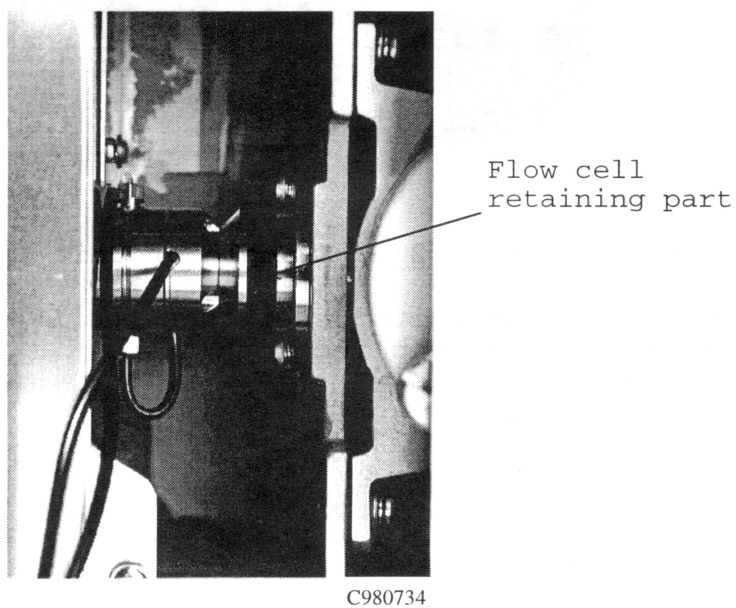


Fig. 2-4 Removal of Sponge for Transport

- (3) Remove the flow cell cover, and take out the flow cell retaining part (1 pc).

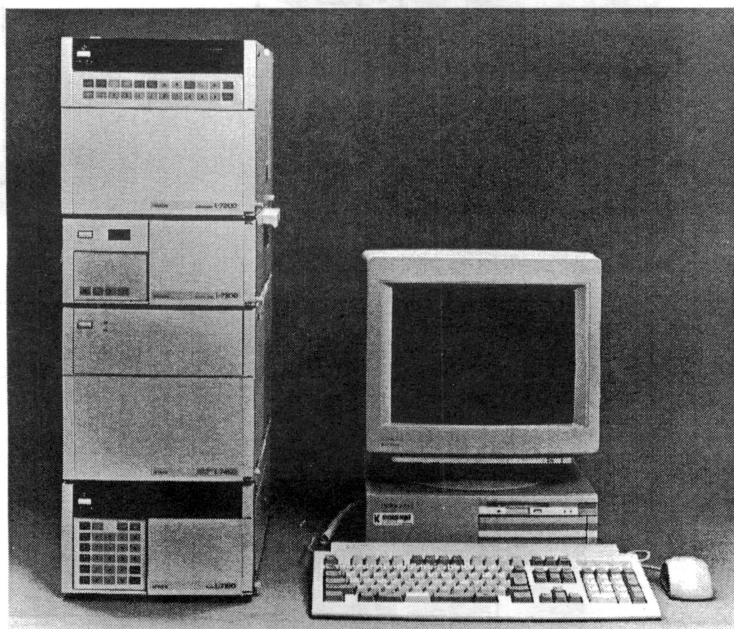


2.3 Example of Layout

2.3 Example of Layout

Figure 2-5 shows an example of combination of the L-7100 pump, L-7200 autosampler, L-7300 column oven, L-7455 DAD and D-7000 HPLC system manager (D-7000 interface and personal computer).

NOTICE: Since these units generate heat, provide a space of at least 30 mm between them and at least 150 mm behind them.



C942993

Fig. 2-5 Example of Unit Layout

For the handling of units other than the L-7455 DAD, refer to the instruction manuals supplied with them.

2.4 Fastening of Units

Units such as the L-7455 DAD, L-7100 pump, L-7200 autosampler and others can be stacked upon one another for use. In this case they can be fastened together to prevent tipover in the event of an earthquake or the like. Retaining plates are used for this purpose.

- (1) Remove the screws holding the covers of the units.
- (2) Attach the retaining plate using the screws removed above.

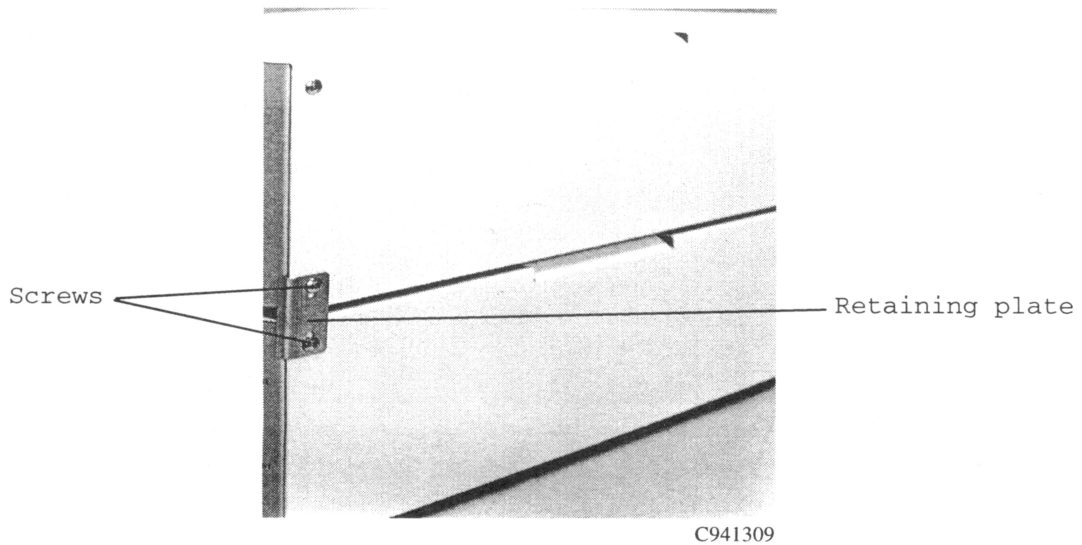


Fig. 2-6 Fastening of Units

3. NAMES AND FUNCTIONS OF COMPONENTS

3.1 Front Panel

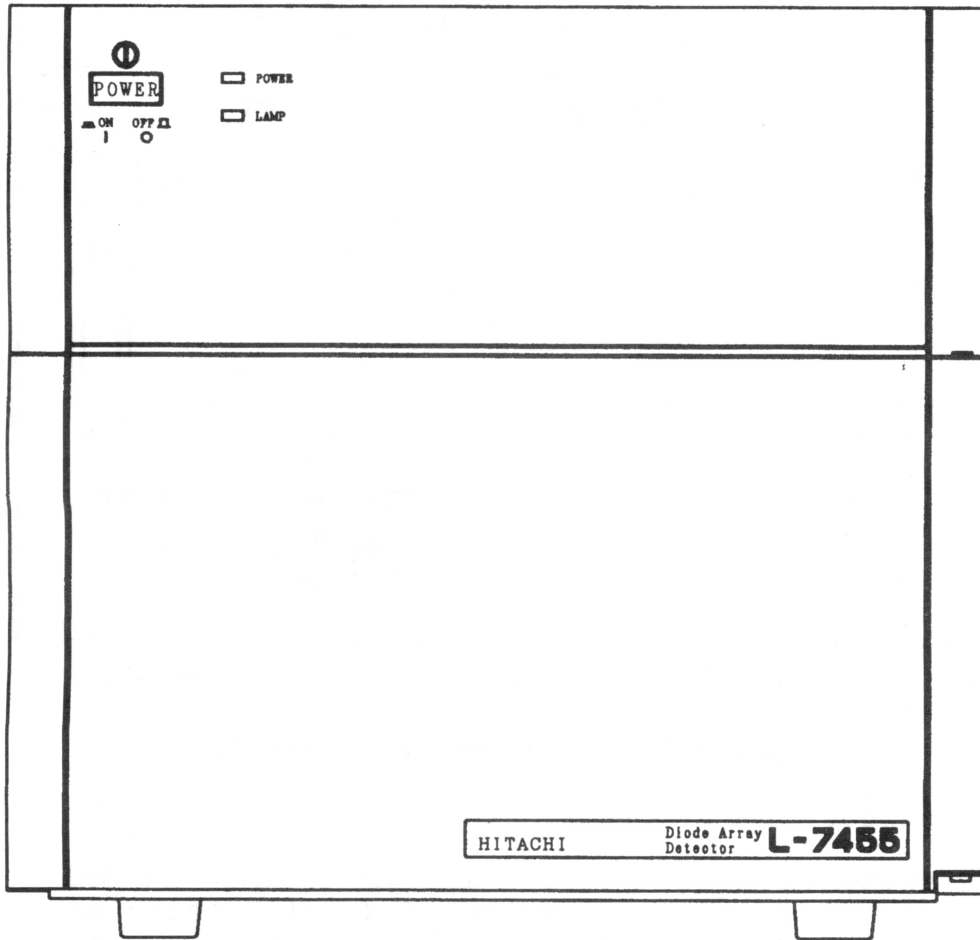


Fig. 3-1 Front View of L-7455 DAD

- POWER switch : Turns power ON and OFF.
- POWER lamp : Lights in green when power is turned ON.
Lights in orange when SYSTEM error occurs.
- LAMP lamp : Comes on when light source lamp is lit.

3.2 Rear Panel

3.2 Rear Panel

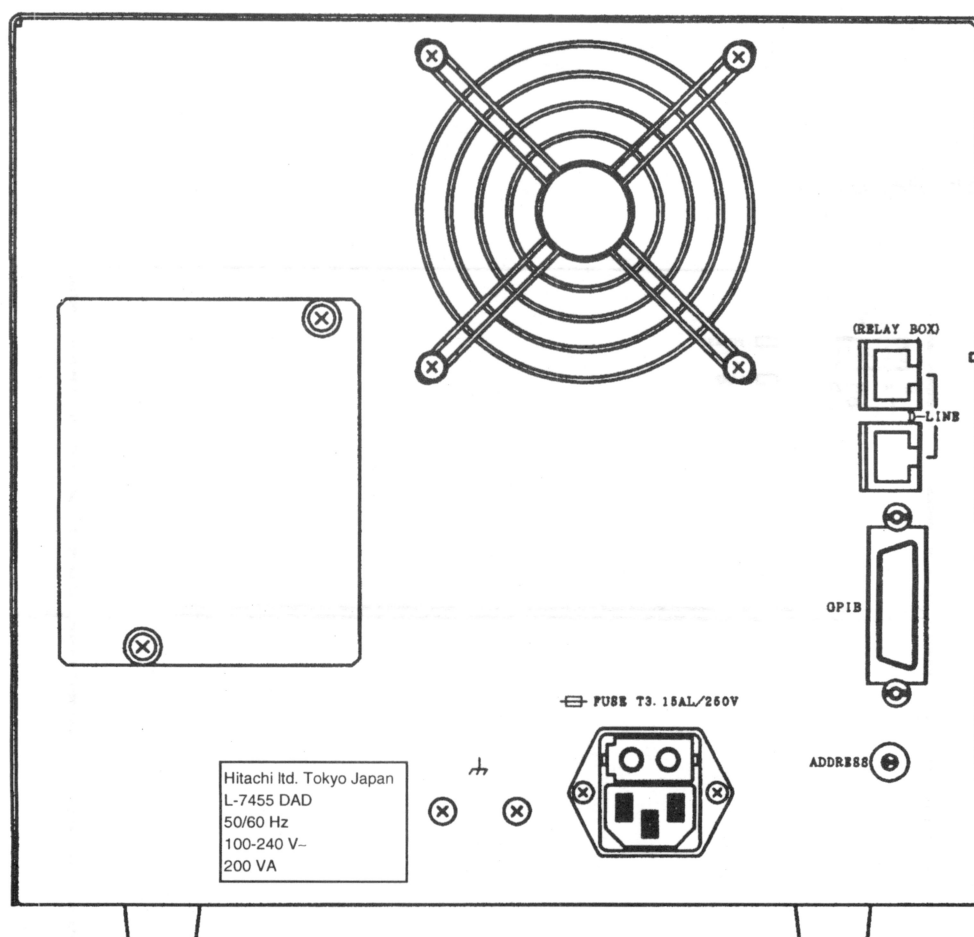



Fig. 3-2 Rear View of L-7455 DAD

- GPIB connector : Connects GPIB cable for communication with PC.
- ADDRESS switch : Used to set an address no. for GPIB communication. Default setting is "7".
(Where two units are used, assign "7" to the first unit and "6" to the second unit.)
- D-LINE connector : Connects a D-line cable.)
-  (GND terminal) : Used to ground the unit.
- Fuse holder : Holds two fuses.
- Power connector : Connects the power cord.

3.3 Operating Principle

The optical system of the L-7455 DAD is shown in Fig. 3-3. The light beam emitted from the D_2 lamp is condensed inside the flow cell via the lens. The light is then absorbed by the solvent or sample in the flow cell, is narrowed via the slit and then irradiated into the detector. The irradiated beam is condensed onto the concave mirror, dispersed via the prism, reflected onto the concave mirror again, and then converted into an electrical signal at the photodiode array (PDA). In wavelength accuracy check, the shutter mirror cuts off a beam from the D_2 lamp and reflects a beam from the Hg lamp to the detector.

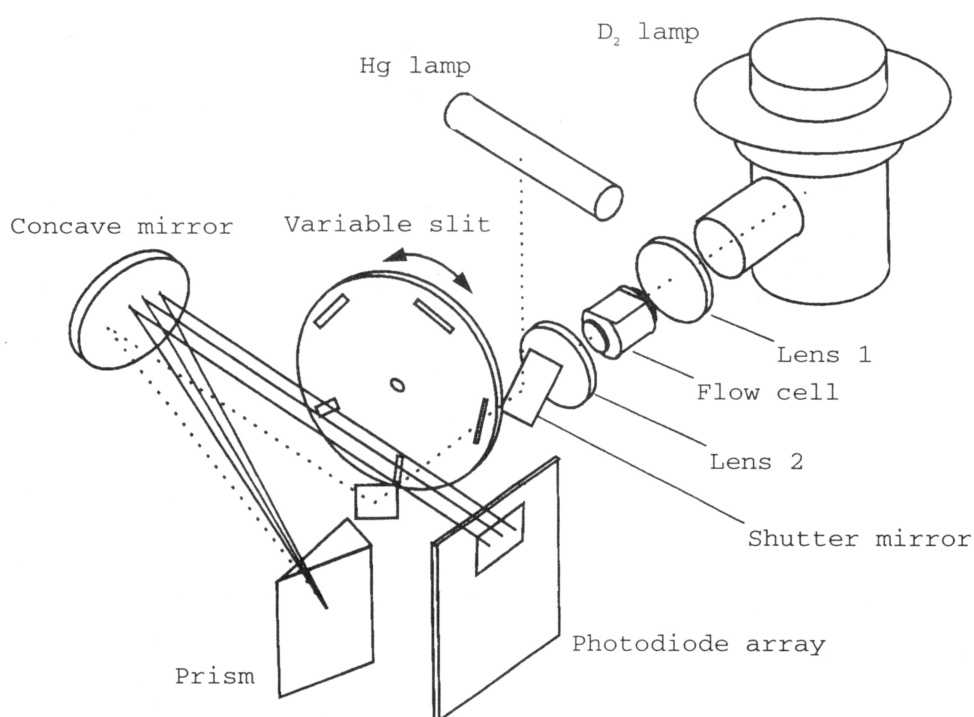


Fig. 3-3 Optical System of L-7455 DAD

3.4 Specifications

3.4 Specifications

(1) Power Requirement, Dimensions, etc.

- (a) Power requirement & consumption : 100 to 240 V AC (50/60 Hz), 200 VA
- (b) Operating temperature range : 4 to 35°C (non-condensing)
- (c) Operating humidity range : 45 to 85% RH
- (d) Dimensions : 260 mm W × 500 mm D × 235 mm H
- (e) Weight : Approx. 16 kg

(2) Optical System

- (a) Photometric method : Prism dispersion, single beam photometry
- (b) Light source : D₂ lamp
- (c) Detecting element : 512-bit photodiode array
- (d) Measuring wavelength range : 190 to 800 nm (settable in 1 nm steps)
- (e) Wavelength accuracy : ±1 nm (at 253.7 nm)
- (f) Slit width (wavelength resolution)* : 1, 2, 4, 8, 16 nm (253.7 nm), selectable
- (g) Spectral bandpass : 1, 2, 4, 8, 16 nm, selectable
- (h) Spectrum acquisition cycle : 100, 200, 400, 800, 1600, 3200 ms, selectable
- (i) Absorbance range : -0.2 to 2 AU
- (j) Noise : 1.5×10^{-5} AU or less
(Conditions: air inside cell, spectral bandpass 4 nm, on smoothed chromatogram at 250±10 nm, ambient temperature 25°C, ambient temp. fluctuation within ±1°C, measured after warmup)
- (k) Drift : 1×10^{-3} AU/h or less
(Conditions: air inside cell, spectral bandpass 4 nm, wavelength 250 nm, ambient temperature 25°C, ambient temp. fluctuation within ±1°C, measured after warmup)
- (l) Linearity : 1 AU max. (wavelength range 210 to 400 nm)
- (m) Standard flow cell : Quartz cell, optical path length 10 mm, capacity 17.7 µL, withstand pressure 1.0 MPa (10 kgf/cm²)
- (n) Max. analysis time : 10 hours
(spectral bandpass 4 nm, spectrum acquisition cycle 1600 ms, measured wavelength range 190 to 800 nm)

- (o) GLP related functions *
- Wavelength calibration (using built-in Hg lamp)
 - Wavelength accuracy check (using built-in Hg lamp)
 - Check of D₂ lamp energy
 - Check of D₂ lamp usage time, no. of ignitions
 - Check of Hg lamp usage time, no. of ignitions

(3) Communication

- (a) GPIB : Communication with personal computer (D-7000 HPLC system manager)
- (b) D-line : Only contact function used
(START-IN, STOP-OUT, BUSY-IN/OUT)

(4) Options

- (a) Analog signal output unit (part No. 810-2876)
- (b) Flow cell unit

Part No.	Part Name	Cell Capacity	Optical Path Length	Withstand Pressure	Remarks
810-2874	Standard flow cell for L-7455	17.7 μ L	10 mm	1.0 MPa	Standard accessory
810-2890	Semi-micro flow cell for L-7455	3.2 μ L	5 mm	1.0 MPa	Stainless steel tubing used
810-2892	Preparative flow cell for L-7455	3.5 μ L	0.5 mm	1.0 MPa	Usable up to 30 mL/min flow rate
810-2891	High-pressure Semi-micro flow cell for L-7455	3.2 μ L	5 mm	14.7 MPa	Stainless steel used for cell, tubing

- (c) Cuvette holder (part No. 810-2895)

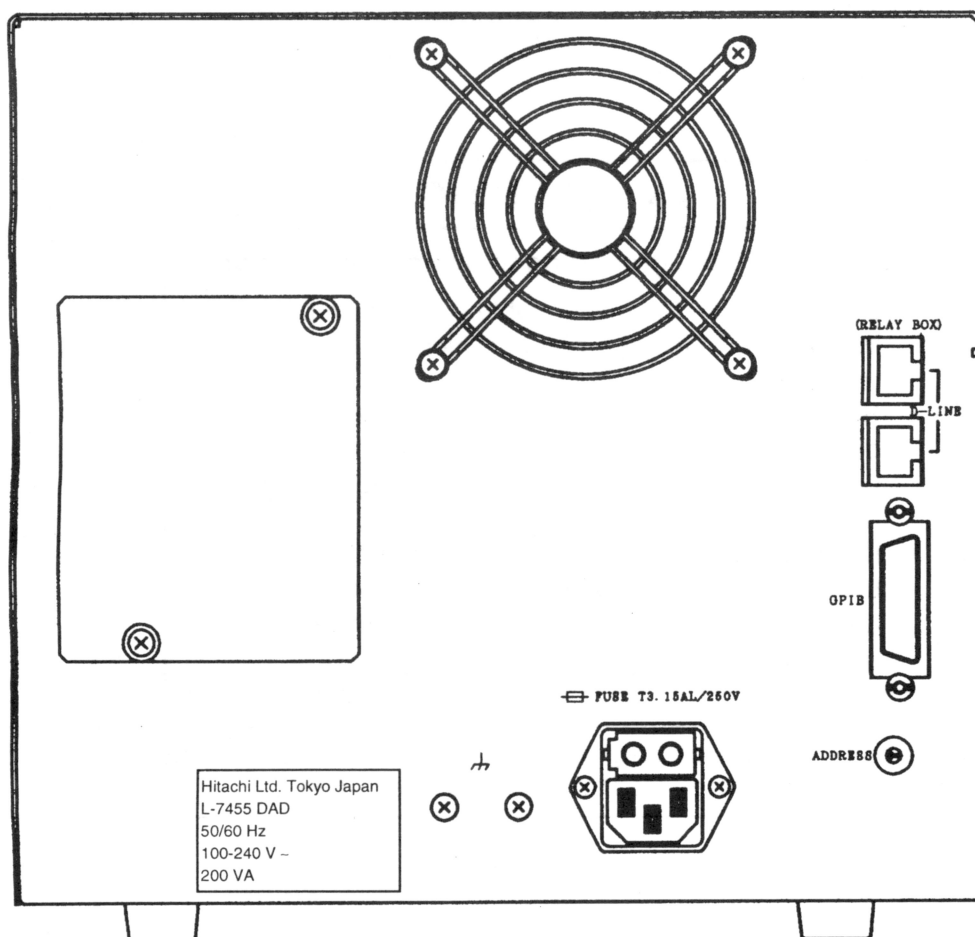
* D-7000 HPLC system manager is required for change of wavelength resolution and for GLP-related functions.

4. OPERATION

4.1 Preparation for Operation

4.1.1 Check of Power Voltage

Make sure the voltage to be input matches the voltage setting of the instrument. The voltage setting is indicated on the rear panel of the instrument.



4.1 Preparation for Operation

[Cautions on Use of Leakage Breaker]

When a leakage breaker is attached to the power supply for preventing an electric shock or fire hazard, be careful about the following points.

- (1) Use a breaker that will not operate at a current having an unnecessary high frequency component other than the commercial frequency (50/60 Hz).
- (2) Recommended Leakage Breaker

Hitachi type EB-50C (single phase 20 A, detectable leakage current 30 mA)

All of Hitachi's leakage breakers presently being produced include countermeasures for high frequency. Some breakers of other make also include such countermeasures. Be sure to check on this before selecting a breaker for use.

4.1.2 Wiring

WARNING

Perform suitable grounding to avoid electric shock.

- Be sure to use the power cable supplied with the instrument. Use of a non-specified cable could result in an electric shock hazard.
- Since this instrument is a "plug-connected type device" (European standard EN61010-1), connect the power cable to an outlet for 3-prong plug having a ground terminal.
- If a 3-prong plug outlet cannot be used, then connect the cable to a 2-prong plug outlet via a conversion adapter. In this case make sure to provide a proper grounding.

NOTICE: Before connecting the power cord, make sure the power switch of the instrument is at OFF.

Connect the power and signal cords. When using a plug adapter or table tap, connect the ground wire securely to the ground terminal.

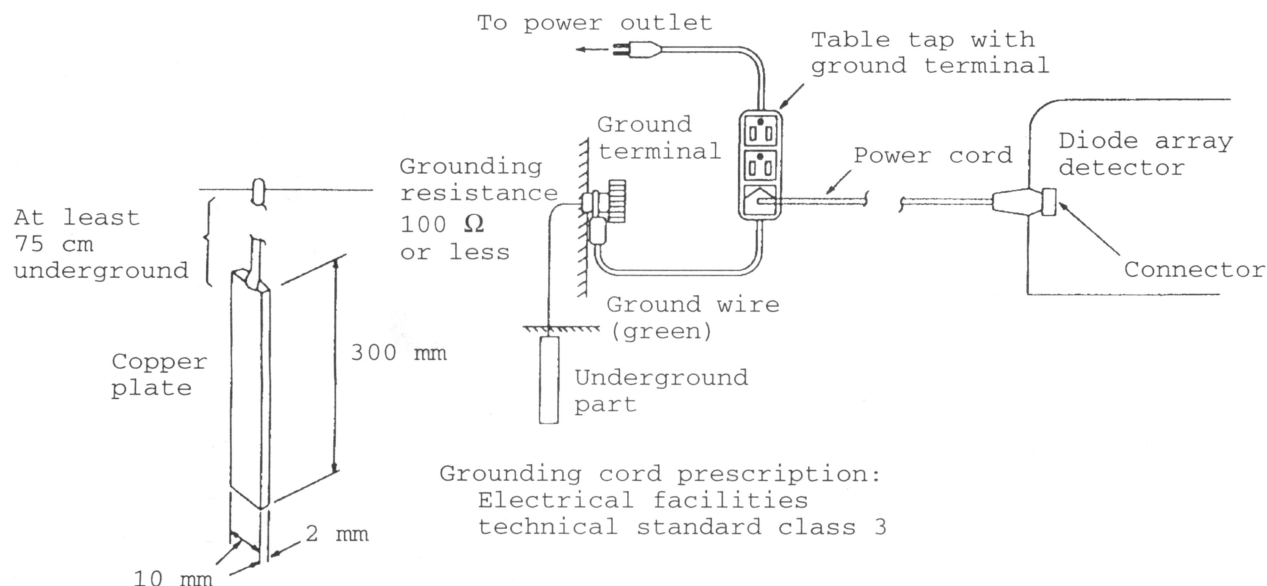
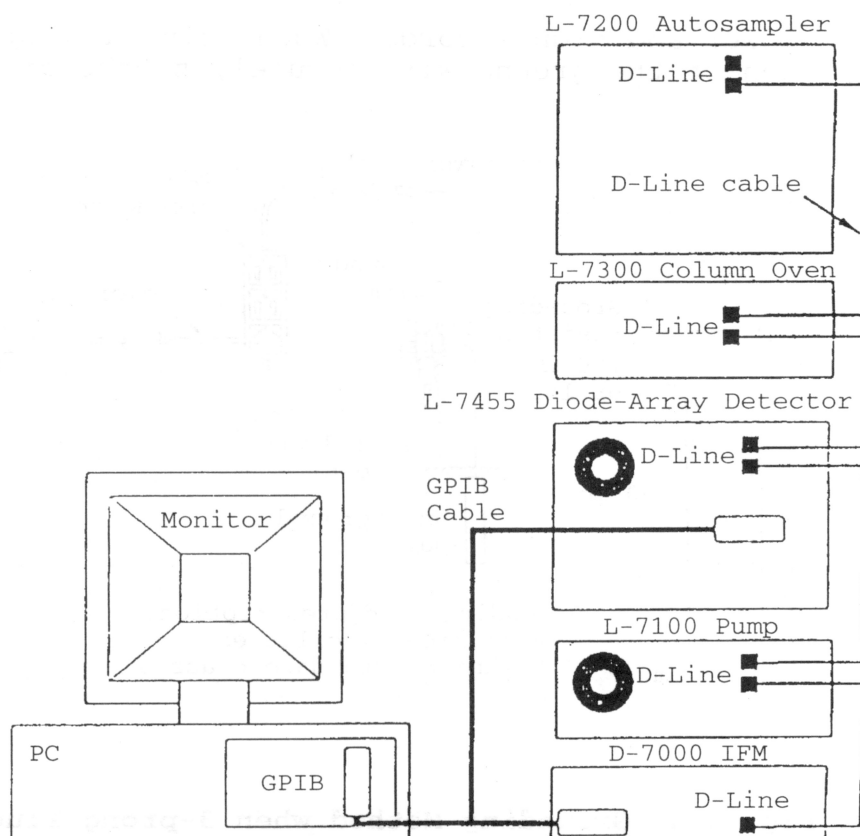


Fig. 4-1 Grounding Method when 3-prong Plug Outlet is not Usable

Connect the power cord and D-line and GPIB cables as indicated in the figure below.

- (1) System A: Use of D-7000 interface enables PC control of other units (pump, etc.) in addition to the L-7455 DAD.
 - (a) Example of configuration
 - D-7000 interface
 - L-7100 pump
 - L-7455 DAD
 - L-7300 column oven
 - L-7200 autosampler

4.1 Preparation for Operation



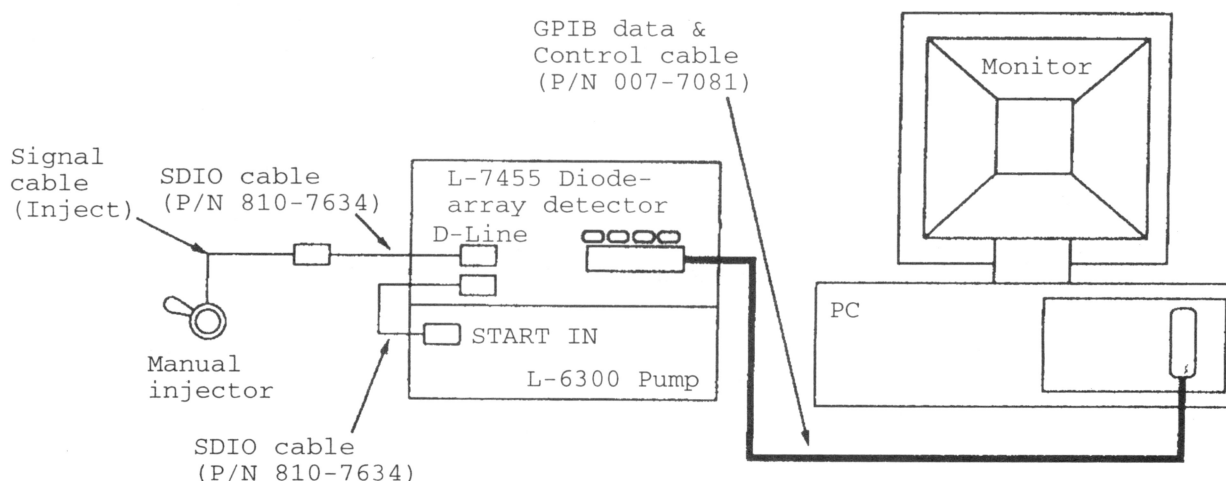
(b) Connection procedure

- 1) Check that the address switch setting is L-7455 DAD=7 and D-7000 interface=F(=15).
- 2) Connect the L-7455 DAD with the other units via D-line cable.
- 3) Connect the L-7455 DAD with the PC via GPIB cable.
- 4) After completing connection, turn on the power for L-7455 DAD and the other units.

(2) System B: PC control of L-7455 DAD is possible. Analysis is started by signal from manual injector.

(a) Example of configuration

- L-6300 pump (L-6000 series pump)
- L-7455 DAD
- Manual injector (for L-7000 series)



(b) Connection procedure

- 1) Check that the address switch setting is "7".
- 2) Connect the manual injector with the L-7455 DAD via SDIO start cable (option).
- 3) Connect the L-6300 pump with the L-7455 DAD via SDIO cable (option) to enable starting the L-6300 program simultaneously with sample injection.
- 4) Connect between L-7455 DAD and the PC with GPIB cable.
- 5) After completing connection, turn on the power for L-7455 DAD and the other units.

4.1 Preparation for Operation

4.1.3 Tubing

Connect the inlet tube to the column outlet and the drain tube to the drain bottle.

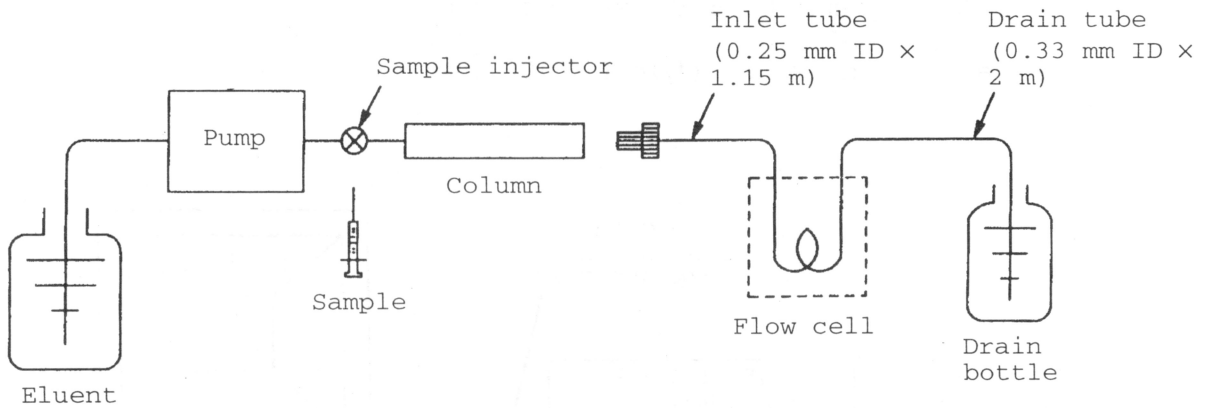


Fig. 4-2 Example of Tubing

4.2 Operation

The fundamental operation and functions are explained here centered on the key operation. Be particularly careful when handling chemicals such as organic solvent.

WARNING

Beware of ignition of flammable chemicals !

- There is a danger of ignition when using flammable chemicals such as organic solvent.
- Always check the flow path for the following, and if an abnormality is found, stop the operation immediately.
 - ◇ Leakage of solvent or waste solution during use
 - ◇ Leakage of solvent inside instrument
- Provide sufficient ventilation in the room.
- This instrument is not explosionproof.

Although aqueous solvents or organic solvents having an ignition point above 70°C are usable, avoid using organic solvents having an ignition point below 70°C.
- Be careful about ignition due to static electricity when using flammable chemicals. Especially when using a nonconductive chemical, utilize a conductive vessel and carry out grounding correctly.

WARNING

Beware of explosion of flammable chemical vapor !

- If a flammable chemical such as organic solvent leaks from the instrument flow path, and the vapor from the solvent exceeds the explosion limit, there is a danger of explosion.
- When using a flammable easily-vaporized chemical like organic solvent, always check for liquid leakage from the flow path, and provide sufficient ventilation in the room.

4.2.1 Power On

Turn ON the power switch of this unit. The POWER lamp comes on and the unit is initialized. When initialization is finished, the LAMP lamp comes on.

4.2 Operation

4.2.2 Notes on Operation

The data acquisition parameters, photometric values, error information and the like for the L-7455 DAD are all controlled/managed by the PC (D-7000 HPLC system manager). Three-dimensional data acquisition is started by start signal (D-line) from the L-7455 DAD, and chromatograms are monitored in real time on the PC during the acquisition. When a single analysis is finished, the three-dimensional chromatogram data saved in the L-7455 is retransmitted to the PC and saved in the PC's hard disk.

Three-dimensional chromatograms are used for peak purity check, peak component identification, and library data creation/retrieval by means of the contour line display and 3-dimensional chromatogram display functions on the PC screen. Also, quantitative calculation is made for the peaks appearing on ordinary chromatograms. For the D-7000 HPLC system manager functions and operating method, refer to the instruction manual supplied with it.

For adding the L-7455 DAD to an HPLC system in use, set the GPIB communication parameters suitably on the PC side. Refer to the "D-7000 HPLC System Manager Software Installation Manual" for the setup method.

4.2.3 Shutdown

Turn OFF the power to the unit to shut it down. Note that the D-7000 HPLC system manager should be shut down prior to this unit.

4.2.4 After Use

After using salty solutions such as buffer solutions, make sure to rinse the flow cell adequately with distilled water. Otherwise the flow cell may become clogged, resulting in damage.

5. SYSTEM CONFIGURATION

5.1 HPLC System

Figure 5-1 shows the configuration of the HPLC system. The components ranging from the PC that contains the D-7000 HPLC system manager software and GPIB (General Purpose Interface Bus) communication interface (IF), up to the D-7000 interface (D-7000 IF) connected via the GPIB is referred to as the "HPLC system manager".

The units included in the D-line network are controlled by PC via the D-7000 IF. And the L-7455 DAD is controlled directly by the PC. Setting and saving of analytical parameters for each unit, and monitoring, saving, and quantitative calculation of chromatograms can all be performed at the PC.

By just selecting the analytical parameter file (Method) at the PC, the analytical, calculation and report parameters are all set and analysis is started automatically.

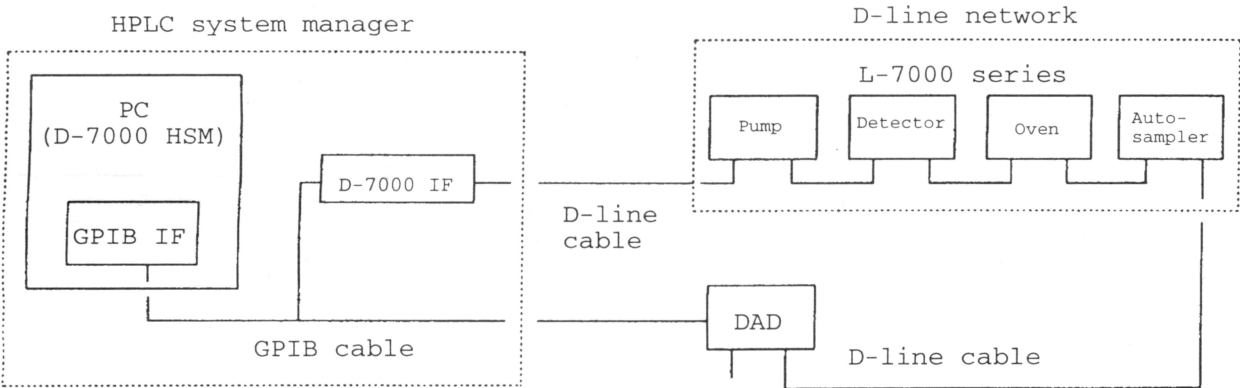


Fig. 5-1 HPLC System Configuration

5.2 Communication System

5.2 Communication System

The L-7455 DAD includes functions for "GPIB communication" with the PC and a "D-line network" communication system for automating liquid chromatography.

(1) GPIB Communication

This system enables the PC (D-7000 HPLC system manager) to control/manage all the L-7455 DAD functions (data acquisition parameters, photometric data, error information, etc.).

(2) D-line Network

The L-7455 DAD complies with the "contact mode" of the D-line network. Table 5-1 gives the D-line functions of the L-7455.

Table 5-1 D-line Functions


Contact Name	In/Out (format)	Signal Description	Function
START IN	In (pulse)	When shorted for 100 msec or longer, it is judged that input is present.	Starts data acquisition.
STOP (ERROR) OUT	Out (level)	When the instrument is forced to stop due to occurrence of an error, LOW level is taken (contact closed).	Other instrument is stopped.
BUSY OUT	Out (level)	Assumes LOW level (contact closed) in BUSY status.	It is assumed to be BUSY when each function is activated or at preparatory step.
BUSY IN	In (level)	When at LOW level (contact closed), it is judged to be BUSY status.	Data acquisition cannot be started.


NOTICE: Contact rating is 30 V DC, 0.1 A.

6. OPERATION AND PERFORMANCE CHECKUP

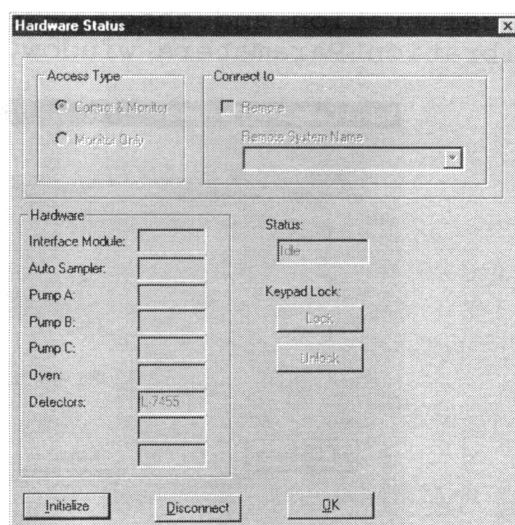
For checking operation and performance of Model L-7455 DAD, provide connection with D-7000 HPLC System Manager. For the operational procedures, refer to the D-7000 HPLC System Manager Instruction Manual.

6.1 Operation Check

- (1) Provide grounding and wiring connections for this instrument.
- (2) Turn on the power switch of this instrument, and make sure that the POWER indicator and LAMP indicator are lit.
- (3) Call up the D-7000 System Manager, and click the System Status check icon  to open the dialog box.

On the dialog box, click the  button. Then, a connection with this instrument is set up, and the program is downloaded. (It takes approx. two minutes to complete program downloading.)

- ☒ Check: At the end of program downloading, check that 'L-7455' is indicated on the detector.



6.2 Performance Check

6.2 Performance Check

Performance check at the time of installation should be carried out under the following conditions:

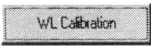
- Install the instrument at a place having a room temperature ranging from 20 to 30°C with variation of $\pm 1^\circ\text{C}$ or less (not exposed directly to air current from air-conditioning facility).
- After power-on, perform warming-up for at least 60 minutes.
- The content of a flow cell should be air.

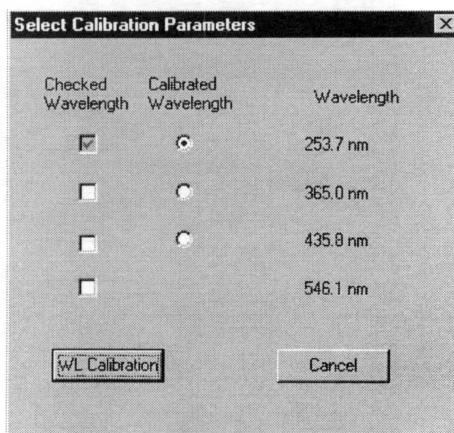
NOTICE: If the inside of the flow cell is contaminated or not dried up completely, accurate performance check may not be made.
If the flow cell is contaminated, be sure to clean it before use (refer to Item 7.2 - Checking and Cleaning the Flow Cell).

- For noise value check, use data attained with fluctuation in the baseline drift minimized.

(1) Wavelength Accuracy Check


For wavelength accuracy check, use the incorporated Hg lamp (refer to Appendix 1 "Description of L-7455 DAD Unit Validations - Wavelength Accuracy Check"). Take the following procedure.

- (a) On the main window of D-7000 HPLC System Manager, open the "Validate DAD" window and then click the  button.
- (b) Select the calibration and check wavelengths from the Select Calibration Parameters window.

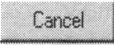


Calibrated wavelength : Wavelength used as a reference when calibrating. Normally a wavelength near the analytical wavelength of the measured sample is selected. One of three wavelengths 253.7, 365.0 and 435.8 nm is selectable.


Checked wavelength : Wavelength other than the calibrated wavelength that is used for checking. Wavelength deviation is indicated for each selected wavelength. Checked wavelength is selectable from 253.7, 365.0, 435.8 and 546.1 nm.

- (c) Click the  button and the wavelength check is made automatically. The results of wavelength accuracy check at 253.7 nm and at slits of 1, 2, 4, 8 and 16 nm are indicated.

WL Calibration					
Slit	Deviation				WL Calib.
	253.7nm	365.0nm	435.8nm	546.1nm	
1nm	+0.0nm	...	...	...	+2
2nm	+0.0nm	...	...	...	+1
4nm	+0.0nm	...	...	...	+2
8nm	+0.0nm	...	...	...	+3
16nm	+0.0nm	...	...	...	+2
<div><div>Adjust</div><div>Cancel</div></div>					

- ☒ Check: Check the wavelength shift at each slit and then click the  button.

* Wavelength recalibration

For recalibration, click the  button after the completion of wavelength accuracy check. The recalibration is thus carried out. (Data obtained is stored into the L-7455 DAD unit.)

NOTICE: Start wavelength recalibration after a sufficient warmup (wait at least one hour after turning on the L-7455). In the recalibration, the entire wavelength range is automatically corrected with respect to a wavelength shift at 253.7 nm. Therefore spectral positions may change to some extent after the recalibration. If the message "Out of adjustable range" is indicated in wavelength calibration, carry out wavelength recalibration again. If the same message is indicated, it means that the automatic recalibration range is exceeded. In this case contact our service representative. (Note that measurement can still be carried out.)

6.2 Performance Check

(2) D₂ Lamp Energy Check

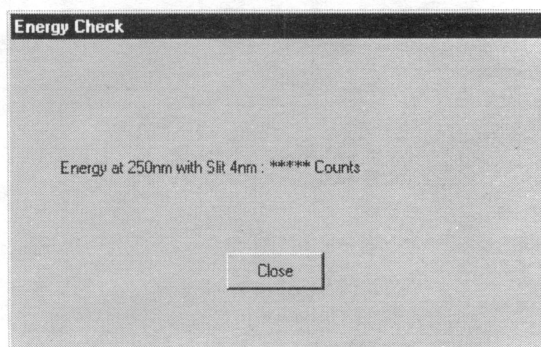
To check energy of the deuterium discharge lamp, use the energy check function of D-7000 HPLC System Manager.

(Refer to Appendix 1 - Description of L-7455 DAD Unit Validations - D₂ Lamp Energy Check.)

Take the following procedure:

- (a) On the main window of D-7000 System Manager, open the 'Validate DAD window' menu and then click the  button.

- (b) A lamp energy value at a wavelength of 250 nm is indicated.





- ☒ Check: Check that the lamp energy value is more than approx. 20,000 counts.

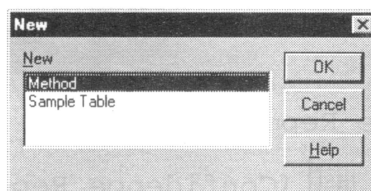
NOTICE: The lamp energy value may vary to some extent depending on the characteristics of the lamp.

(3) Drift/Noise Check

First, set up the D-7000 HPLC System Manager as instructed below.

- (a) Click the  [Change Application] icon of D-7000 HPLC System Manager to open the dialog box.
On the dialog box, select [Samples] and click the [Select] button.
- (b) From the 'File' menu, select the [New] command to open the dialog box.

On the dialog box, select [Method] and click the  button. The Method setup window will then appear.




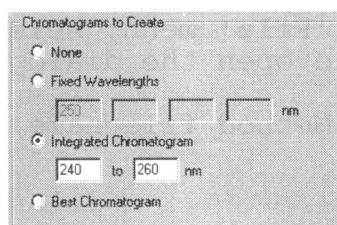
- (c) Specify each analysis file parameter as mentioned below:

- Method Configuration

Click the  [Method Configuration] icon to open the analysis system configuration window.
Select 'L-7455' as a detector.


- DAD Data Processing

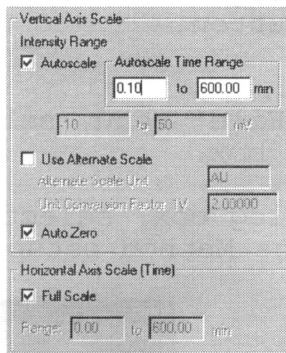
Click the  [DAD Data Processing] icon to open the DAD data processing window.
Select the integrated chromatogram, and specify a wavelength range of 240 to 260 nm.



6.2 Performance Check

- Chromatogram Display Format

Click the  [Chromatogram Display Format] icon to open the chromatogram format window. Check [Auto Zero] for the vertical axis scale, and specify '0.10 to 600.00' as an automatic scale range. For the horizontal axis scale, specify [Full Scale].



Vertical Axis Scale

Intensity Range

☒ Autoscale Autoscale Time Range

0.10 to 600.00 min

10 to 60 mV

☐ Use Alternate Scale

Alternate Scale Unit AU

Unit Conversion Factor 1V 2.0000


☒ Auto Zero

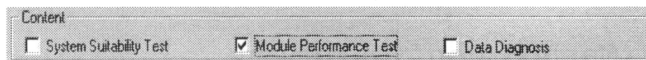
Horizontal Axis Scale (Time)

☒ Full Scale

Range: 1.00 to 600.00 min

- Confidence Report


Click the  [Confidence Report] icon to open the confidence report window. Check [Module Performance Test] for the contents of report.

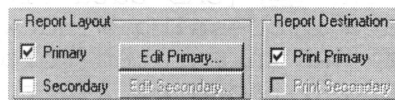


Content

☐ System Suitability Test ☒ Module Performance Test ☐ Data Diagnosis

- Report Format

Click the  [Report Format] icon to open the report format window. Check [Primary] for report layout and [Print Primary] for report destination.



Report Layout

☒ Primary Edit Primary...

☐ Secondary Edit Secondary...

Report Destination

☒ Print Primary


☐ Print Secondary

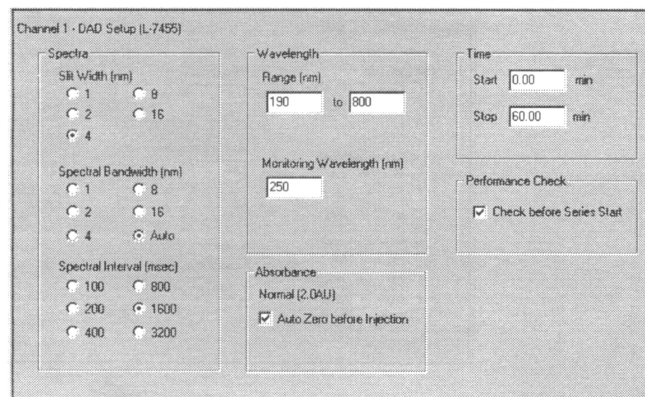
- (d) From the 'File' menu, select the [Save Method as] command to open the dialog box.

Enter an Method file name, and click the  button.

< Drift Value Check >

Take the following procedure:

- 1) Open the Method setup window, and click the  [Channel 1 Detector Setup] icon. Then, the DAD setup window is opened.
- 2) Specify each parameter as shown below. As a stop time, specify '60.00 min'.



Channel 1 - DAD Setup (L-7455)

Spectra

Slit Width (nm)
☐ 1 ☐ 8
☐ 2 ☐ 16
☒ 4

Spectral Bandwidth (nm)
☐ 1 ☐ 8
☐ 2 ☐ 16
☐ 4 ☒ Auto

Spectral Interval (msec)
☐ 100 ☐ 800
☐ 200 ☒ 1600
☐ 400 ☐ 3200

Wavelength

Range (nm)
 190 to 800

Monitoring Wavelength (nm)
 250

Time

Start 0.00 min
 Stop 60.00 min

Performance Check

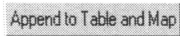
☒ Check before Series Start

Absorbance

Normal (2.0AU)
☒ Auto Zero before Injection



- 3) From the 'File' menu, select the [New] command to open the dialog box.

Select [Sample Table] and click the  button. Then, the sample table setup window is opened.

- 4) As a method name, specify a method that has been created at (3) - 4), and uncheck [Perform Calibration]. Enter '0' as an injection volume (μL), and click the  button.

- 5) From the 'File' menu, select the [Save sample as] command to open the dialog box.

Enter a sample table file name, and click the  button.


- 6) On the main toolbar, click the  [Run Data Acquisition] icon to open the sample table for data acquisition. Specify a sample table file that has been prepared at the above step 4), and click the  button. Data acquisition will then be carried out.

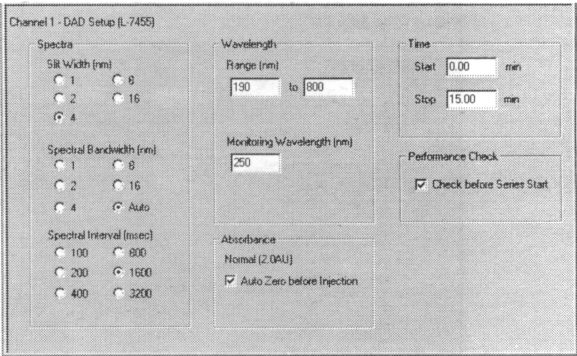
- 7) On completion of data acquisition, calculate a drift value using an automatically printed chromatogram.



NOTICE: Even after completion of warming-up, a drift may increase if the selected slit is changed. Therefore, after slit re-selection, allow a warming-up period of 15 to 20 minutes and then proceed to measurement.

< Noise Value Check >

Take the following procedure:

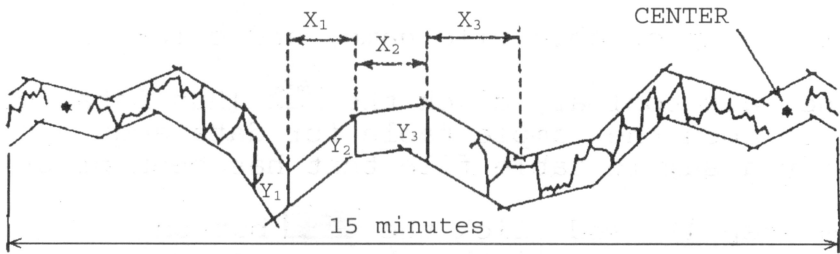
- 1) Open the method setup window, and click the  [Channel 1 Detector Setup] icon. Then, the DAD setup window is opened.
- 2) Specify each parameter as shown below. As a stop time, specify '15.00 min'.



- 3) On the main toolbar, click the  [Run Data Acquisition] icon to open the sample table for data acquisition. Specify a sample table file that has been used for drift value check, and click the  button. Data acquisition will then be carried out.
- 4) On completion of data acquisition, calculate a noise value using an automatically printed chromatogram.

Noise value = $\sum_{R=1}^{R=n} Y_R / n$ (Xn: increments of 0.5 min)

Noise calculation (Excerpted from ASTM E685-79)



7. MAINTENANCE AND CHECK

7.1 Periodic Checkup

Check Item	Frequency of Check (recommended)	Check Method	Reference Paragraph
Lighting of light source lamp	Daily	Make sure that the LAMP indicator is lit.	Refer to 6.1.
Useful live of light source lamp	Monthly	1) Carry out energy check for inspection of the useful life of the light source lamp. 2) In inspection of the useful life of the lamp, check for any significant variation in baseline (fluctuation or increased noise).	Refer to 6.2 (2). Refer to 6.2 (3).
Wavelength accuracy	Yearly	Check wavelength accuracy through wavelength calibration.	Refer to 6.2 (1).

7.2 Checking and Cleaning the Flow Cell

7.2 Checking and Cleaning the Flow Cell



WARNING

Ignition of Flammable Chemicals!

- Beware of ignition hazard when using flammable organic solvents such as ethanol, methanol, etc. for cleaning the flow cell.
- Always check the following conditions. If an abnormality is found, take a proper countermeasure.
 - ◇ There should be no heat source or flame near the workplace.
 - ◇ The workplace should be well ventilated.



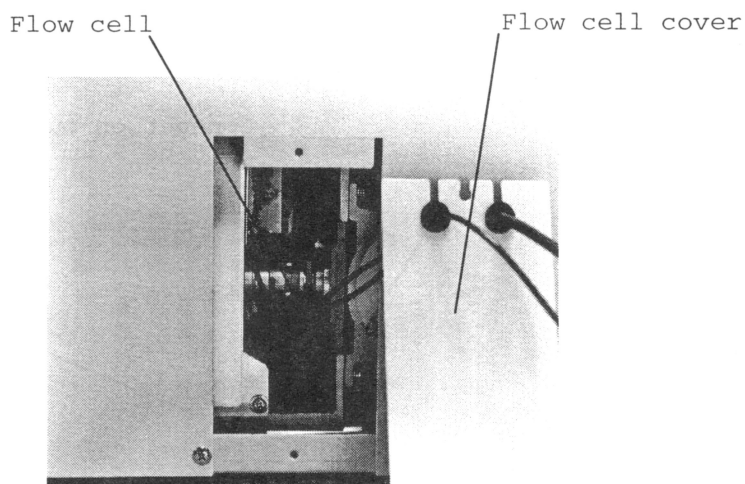
CAUTION

Harmful Vapor of Organic Solvents if Inhaled!

- Organic solvents such as ethanol, methanol, etc. used for cleaning the flow cell is harmful to your health. When using these organic solvents, be sure to observe the following instructions:
 - ◇ The work should be completed within the shortest possible time.
 - ◇ Be sure to wear protective gloves.
 - ◇ Use tweezers or the like when handling gauze moistened with organic solvent, taking care not to touch it directly.
 - ◇ Use the required minimum amount of organic solvent.
 - ◇ When discarding waste solution, treat it in a specified manner separately from other ordinary waste.
- The workplace should be ventilated locally as required. Be careful not to inhale vapor of organic solvent.

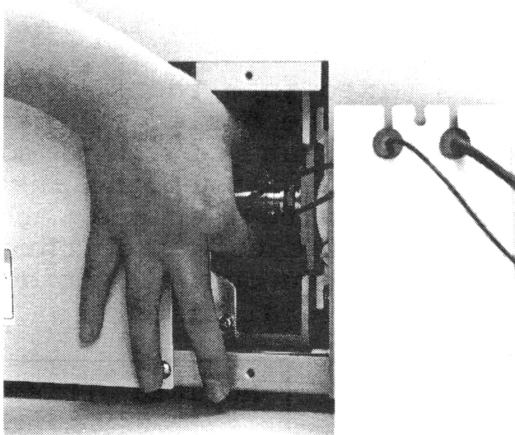
The inside of flow cell must be free from contamination. Therefore, check and clean the flow cell frequently. When checking and cleaning the flow cell, take the following procedure:

- (1) Open the flow cell cover located at the side panel of the instrument. (The cover retaining screws can be loosened with hand.)



C980733

- (2) Pull the flow cell straight in the arrow direction. Then, remove that by pulling it outside.

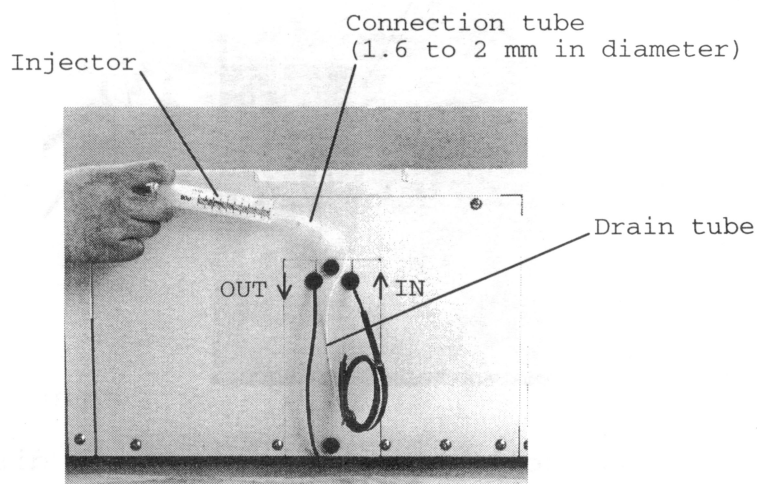


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- (3) Check the circumference of the flow cell for leakage of liquid.

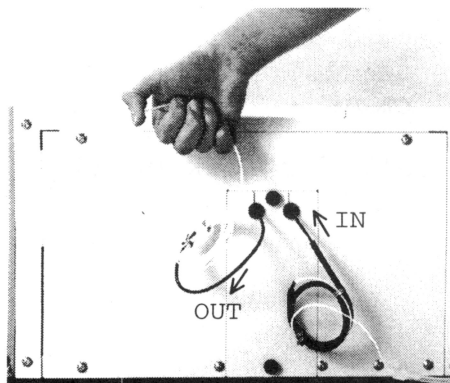
7.2 Checking and Cleaning the Flow Cell

- (4) Check the inside of the flow cell for any foreign substance (crystallized substance), contamination, etc.
If the inside of the flow cell is contaminated, it is required to clean the flow cell. Note that a proper kind of cleaning solution differs depending on the eluent employed for analysis. In case of aqueous eluent, use distilled water. In case of organic solvent eluent, use ethanol or acetone.
- (5) Put cleaning solution into an injector (made of glass, approx. 10 cc), attach it to the end of the drain tube, and clean the flow cell by injection.



C980216

- (6) Replace the cleaning solution with the eluent to be used for analysis, and clean the flow cell in the same manner.
- (7) If an air bubble is mixed into the flow cell, put your finger (wear gloves) on the outlet of the drain tube while pumping liquid at a flow rate of 1.0 mL/min with pressure of 1.0 MPa (10 kgf/cm²) or less. Let the inside of the flow cell be pressurized for a few seconds, and then release your finger immediately. Repeat this step three or four times, and an air bubble will come out. If it does not come out, repeat the above step several times.



C980217

NOTICE: If excessive pressure is applied, the flow cell may be damaged or broken.
Before cleaning the flow cell, set the pump pressure limiter to a level of 1.0 Mpa (10 kgf/cm²).

7.3 Disassembling and Cleaning the Flow Cell



WARNING

Ignition of Flammable Chemicals!

- Beware of ignition hazard when using flammable organic solvents such as ethanol, methanol, etc. for cleaning the flow cell.
- Always check the following conditions. If an abnormality is found, take a proper countermeasure.
 - ◇ There should be no heat source or flame near the workplace.
 - ◇ The workplace should be well ventilated.



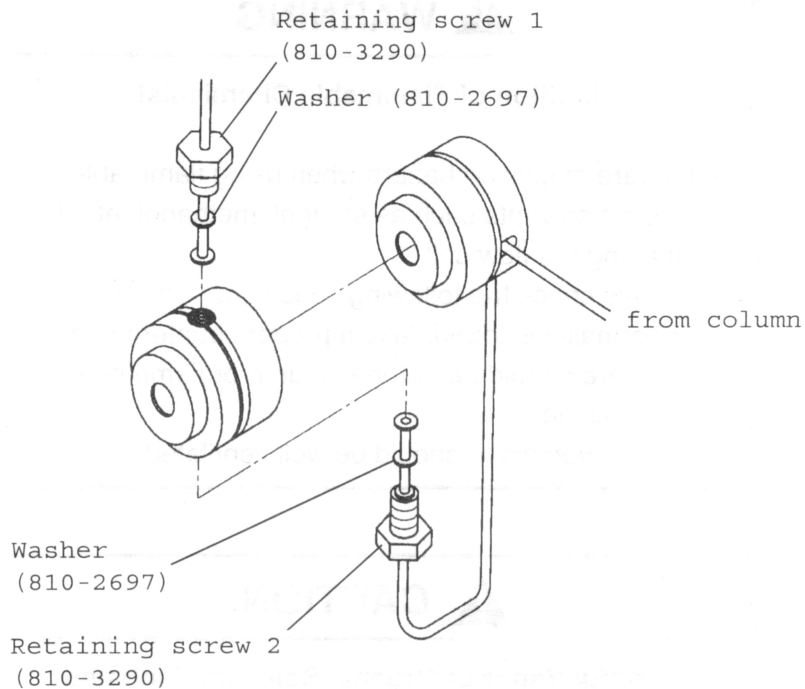
CAUTION

Harmful Vapor of Organic Solvents if Inhaled!

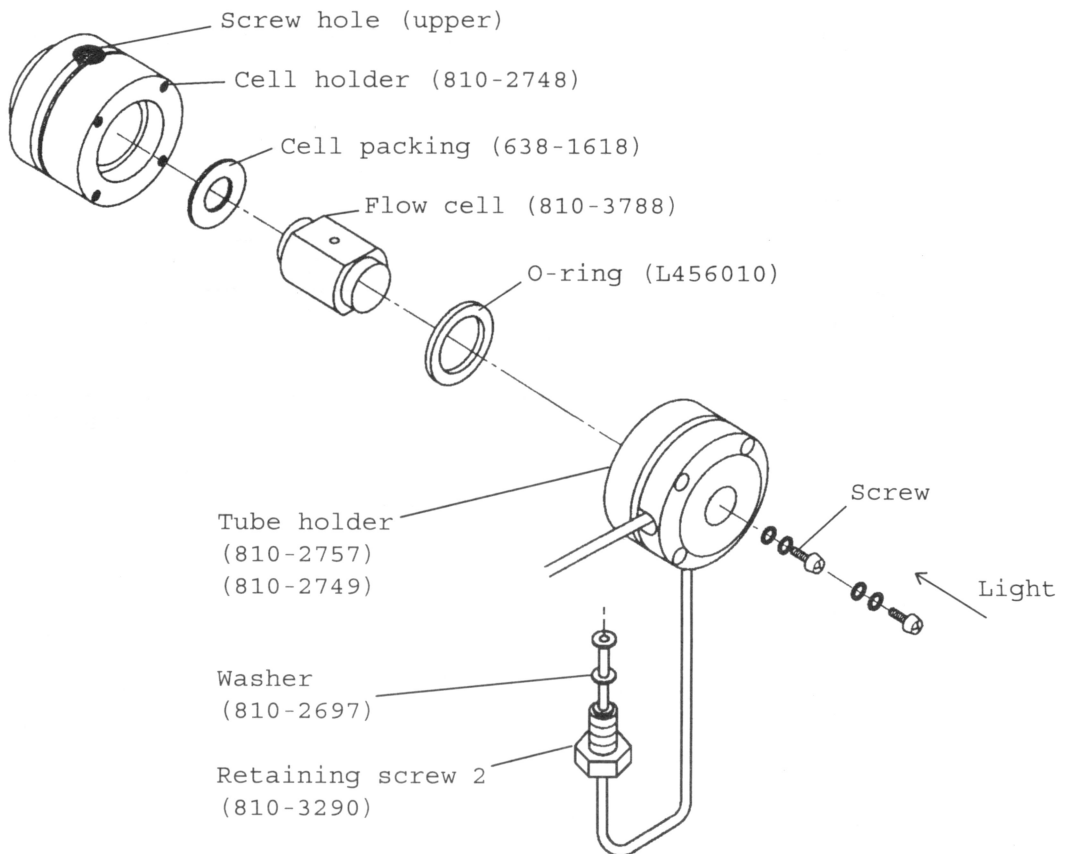
- Organic solvents such as ethanol, methanol, etc. used for cleaning the flow cell is harmful to your health. When using these organic solvents, be sure to observe the following instructions:
 - ◇ The work should be completed within the shortest possible time.
 - ◇ Be sure to wear protective gloves.
 - ◇ Use tweezers or the like when handling gauze moistened with organic solvent, taking care not to touch it directly.
 - ◇ Use the required minimum amount of organic solvent.
 - ◇ When discarding waste solution, treat it in a specified manner separately from other ordinary waste.
- The workplace should be ventilated locally as required. Be careful not to inhale vapor of organic solvent.

7.3 Disassembling and Cleaning the Flow Cell

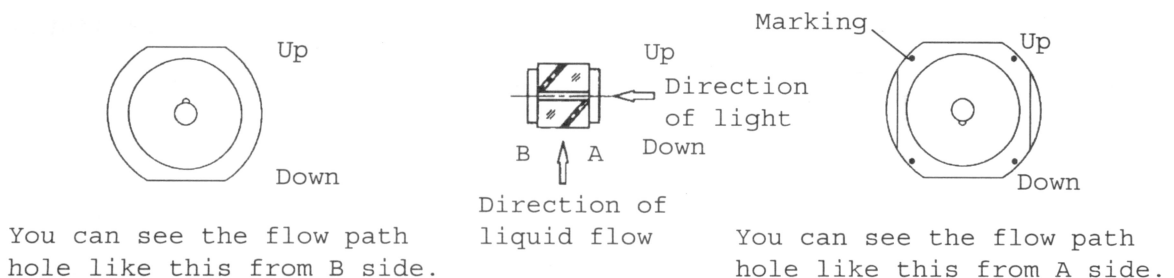
If the inside of the flow cell cannot be cleaned in the procedure mentioned before, disassemble and clean it.



- (1) After removing the retaining screws 1 and 2, detach the tube holder. The tube holder is provided with four screws. At this step remove only two screws located on the rear position. Do not remove two screws located on the front position.
- (2) Remove the flow cell.
- (3) Clean the flow cell using an ultrasonic cleaner.
- (4) Wipe off the surface of the flow cell using gauze moistened with acetone or ethanol.



Enlarged View of Flow Cell



- (5) Put the flow cell into the cell holder so that the upper and lower flow path holes of the flow cell will be aligned with the upper and lower screw holes of the cell holder. The liquid leak hole is provided at the side of the lower screw hole of the cell holder. Use this liquid leak hole for reference in alignment. The side with the marking should come to the A side.
- (6) After reassembling the flow cell unit in the reverse order of removal, try feeding liquid to check that there is no liquid leakage.

NOTICE: Hand-tighten each retaining screw fully, and then retighten it by approx. 30 deg. using a double-ended wrench.

7.4 Countermeasure against Abnormal Operation

7.4 Countermeasure against Abnormal Operation

For operation and maintenance/checkup of the personal computer (PC), printer and HPLC unit, refer to the instruction manuals accompanying them.

Presented below is the troubleshooting table for the L-7455 DAD.

Symptom	Possible Cause	Check	Remedy
The POWER lamp does not light up even when the power switch is turned on.	Poor contact on the power cord plug	Visual check	Reconnect the power cord.
	Fuse blown	Check continuity of the fuse circuit.	Replace the fuse with a new one.
	Improper mounting of the side cover (The protective circuit has been made active.)	Visual check	Retighten the side cover retaining screws.
The POWER lamp illuminates in orange. (The LAMP indicator does not light up.)	Improper connection of the lead wire of light source lamp	Visual check	Reconnect the lead wire of light source lamp referring to the indication on the terminal block.
	Light source lamp broken	Check continuity of the light source lamp.	Replace the light source lamp with a new one.
The POWER lamp illuminates in orange. (LAMP indicator lights up.)	SYSTEM error	Turn power on again. If the same symptom takes place, download the D-7000 HPLC system manager and check the error message.	Refer to the error message list.
Large noise	Flow cell contaminated	Visual check	Clean the flow cell.
	Insufficient deaeration of solvent	Spike noises are produced.	Deaerate the solvent sufficiently.
	Impurities in solvent	Check the solvent.	Purify the solvent, or replace it with a new one.

After initializing Hardware Status of D-7000 HSM, the power lamp indicator remains lit in green.

(cont'd)

Symptom	Possible Cause	Check	Remedy
Large noise	Trouble in the pump	Check whether the pump runs regularly.	Check the pump.
		Check for noise at the stop of the pump.	
	Service life of the lamp	Perform energy check of the light source lamp.	Replace the light source lamp with a new one.
Large drift	Insufficient warming-up		Wait until operation becomes stable (for more than ten minutes).
	Liquid leakage from each joint	Check each joint part.	Retighten each joint lightly.
	Impurities eluted from the column	Stop feeding liquid from the pump.	Wait until elution is completed, or replace the column with a new one.
	Variation in ambient temperature		Make arrangement for minimizing variation in ambient temperature.
	Low-purity solvent used	Check the solvent.	Purify the solvent, or replace it with a new one.

Error Message List

Message	Possible Cause	Remedy
'A ROM error was received from the diode array detector'	Malfunction in electric circuit	Turn on power again.
'A RAM error was received from the diode array detector'		
'An EEPROM error was received from the diode array detector'		
'A lamp error was received from the diode array detector'	D ₂ lamp faulty	Re-mount the D ₂ lamp. If this error message appears again, replace the lamp with a new one.
'A slit initialize error was received from the diode array detector'	Malfunction in slit, etc.	Turn on power again.

7.5 Cautionary Instruction on Occurrence of Failure


(cont'd)

Message	Possible Cause	Remedy
'A light energy error was received from the diode array detector'	Malfunction in slit, shutter, etc.	Turn on power again.
	An air bubble is trapped in the flow cell.	After extracting the bubble (refer to Item 7.2 - Checking and Cleaning the Flow Cell), turn on power again.
	Flow cell not mounted correctly	Make sure flow cell is mounted correctly, then execute initialization or data acquisition again.
	Inside of flow cell contaminated	Clean the inside of flow cell as in 7.3, then execute data acquisition again.
'A Hg lamp error was received from the diode array detector'	Hg lamp no lit	Re-mount the Hg lamp. If this error message appears again, replace the lamp with a new one.
'A PDA error was received from the diode array detector'	Abnormality in PDA	Notify your local Hitachi service office.

In the event of an Hg lamp error, you can use L-7455 after re-initializing Hardware Status of D-7000 HSM. The wavelength accuracy value of the L-7455 is reported at 99 nm.

7.5 Cautionary Instruction on Occurrence of Failure

If a failure occurs in the instrument, be sure to refer repair servicing to qualified Hitachi service personnel. Any person other than personnel qualified and authorized by Hitachi should not attempt to repair the instrument for preventing a possible hazard.

 WARNING
Electronic Shock in Contact with Inside of Instrument!
<p>Before removing the instrument cover for replacement or adjustment of internal parts, be sure to turn off the power switch and unplug the power cord.</p>

8. REPLACEMENT OF PARTS

8.1 Main Parts to be Replaced

The following table shows the main parts having useful life periods in this instrument. Prepare spares for these parts according to the frequency of use. The useful life periods indicated below are calculated on a basis of operation for 160 hours per month (8 hours per day), i.e., 1920 hours per years (240 days per year).

Part Name	Part Number	Useful Life Period (approx.)	Remarks
D ₂ lamp	885-3570	1000 hours/6 months	
Hg lamp unit	810-2816	100 hours/2 years	
Fuse	J821336	1900 hours/year	T3.15A
Flow cell	810-2874	9600 hours/5 years	

8.2 Light Source Lamp Replacement

8.2 Light Source Lamp Replacement

Step 1: Preparation

Turn off the power switch of this instrument, and unplug the power cord.

Step 2: D₂ Lamp Replacement



WARNING

Electric Shock in Contact with Inside of Instrument!

In replacement of the light source lamp, take care not to incur electric shock due to high voltage applied to the inside of the instrument.

Before removing the light source cover for replacement of the light source lamp, be sure to turn off the power switch and unplug the power cord.



WARNING

Never Release Safety Mechanism!

The instrument is designed to shut power off automatically by its safety mechanism when the light source cover is removed.

To prevent electric shock, do not release this safety mechanism intentionally or otherwise.



CAUTION

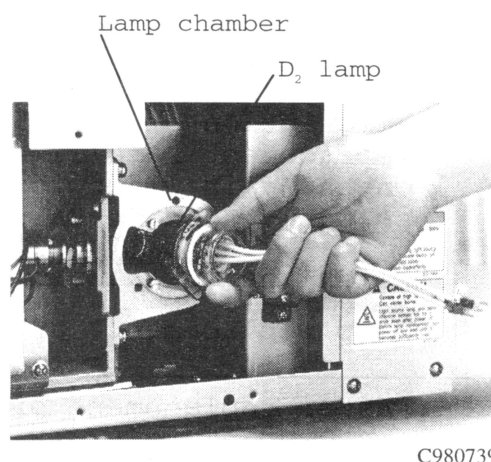
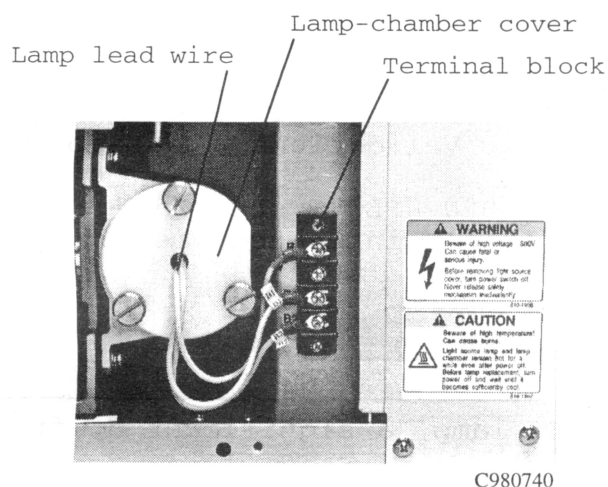
Touching Hot Part Could Result in Burns!

The lamp and the lamp-chamber remain hot for a while even after power-off and can severely burn you if touched.

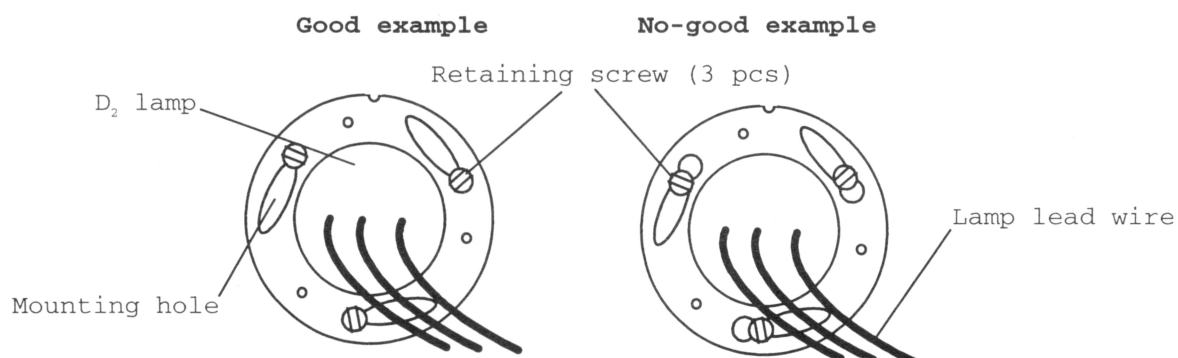
Touching the hot lamp or lamp-chamber in replacement of the lamp could result in burns.

Before attempting replacement of the lamp, turn off the power switch and wait for at least 30 minutes until it becomes sufficiently cool.

- 1) Remove the light source cover located at the side panel of the instrument (loosen five retaining screws).
- 2) Loosen three screws clamping the lead wires of the D_2 lamp, and disconnect the lead wires from the terminal block.
- 3) Loosen three screws clamping the lamp-chamber cover, and remove the cover from the lamp chamber. (At this step, remove each lead wire of the D_2 lamp one by one.)
- 4) Using a flat-blade screwdriver, loosen the D_2 lamp retaining screws (three screws) successively (turn each screw about two turns).
Remove the lamp by turning it clockwise.
- 5) Run each lead wire of a new D_2 lamp through the opening of the lamp-chamber cover.



- 6) Put the new D_2 lamp into the lamp chamber, and turn it counterclockwise so that there will be no gap between the mounting hole and the three retaining screws. Using a flat-blade screwdriver, tighten these retaining screws incrementally in turn. Secure the lamp-chamber cover with the retaining screws.



8.2 Light Source Lamp Replacement

7) Connect the lead wires of the D₂ lamp to the terminal block.

NOTICE: The three lead wires are marked R, B1 and B2. Be sure to connect these lead wires with their correct terminals.

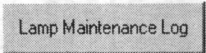
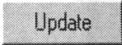
8) Attach the light source cover in place.

Step 3: Operation Check

Plug the power cord into a power outlet, and turn on the power switch. Make sure that the LAMP LED is lit. If the light source cover is not mounted properly, the instrument does not come into operation.

Step 4: Lamp Energy Check (Refer to Appendix 1 - Description of L-7455 DAD Unit Validations - D₂ Lamp Energy Check.)
Perform warming-up for one to two hours, and then check lamp energy using the energy check function of the D-7000 HPLC System Manager.

Step 5: Maintenance Log Setting (Refer to Appendix 1 - Description of L-7455 DAD Unit Validations - D₂ Lamp Replacement Date/Time Input.)
On the main window of the D-7000 HPLC System Manager, select 'Validate DAD' from the 'Maintenance' menu.

Click the  button, enter the date/time of D₂ lamp replacement, and press the  button.

NOTICE: After replacement of the D₂ lamp, a significant drift may occur due to its characteristics.
For high-sensitivity measurement, carry out warming-up for five to ten hours after replacement of the lamp.

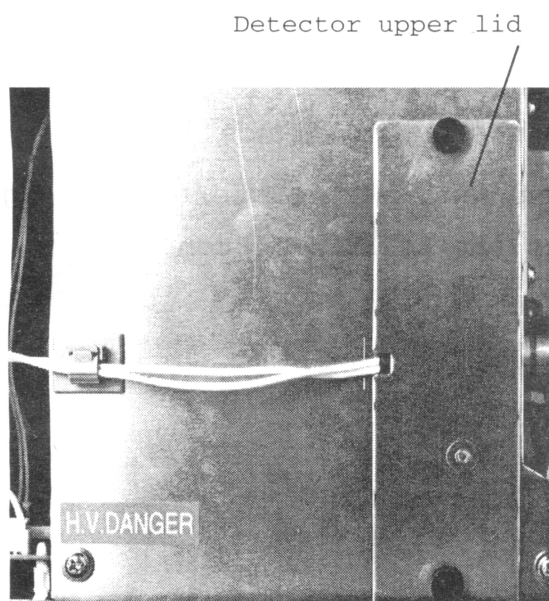
8.3 Hg Lamp Replacement

Step 1: Preparation

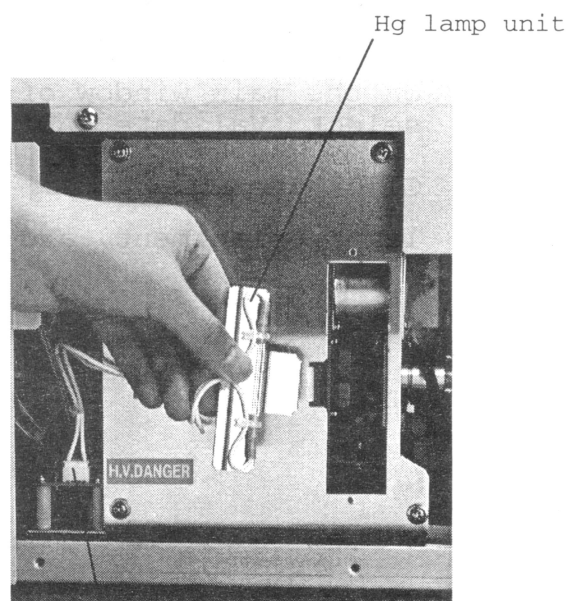
Turn off the power switch of this instrument, and unplug the power cord.

Step 2: Hg Lamp Replacement

- 1) Remove the light source cover located at the side panel of the instrument (loosen five retaining screws).
- 2) Loosen two retaining screws on the upper lid of the detector, and remove the Hg lamp unit.
- 3) Remove the socket from the Hg lamp inverter, and a new Hg lamp unit on the socket.
- 4) Set the new Hg lamp unit in place, and attach the upper lid of the detector.
- 5) Attach the light source cover.



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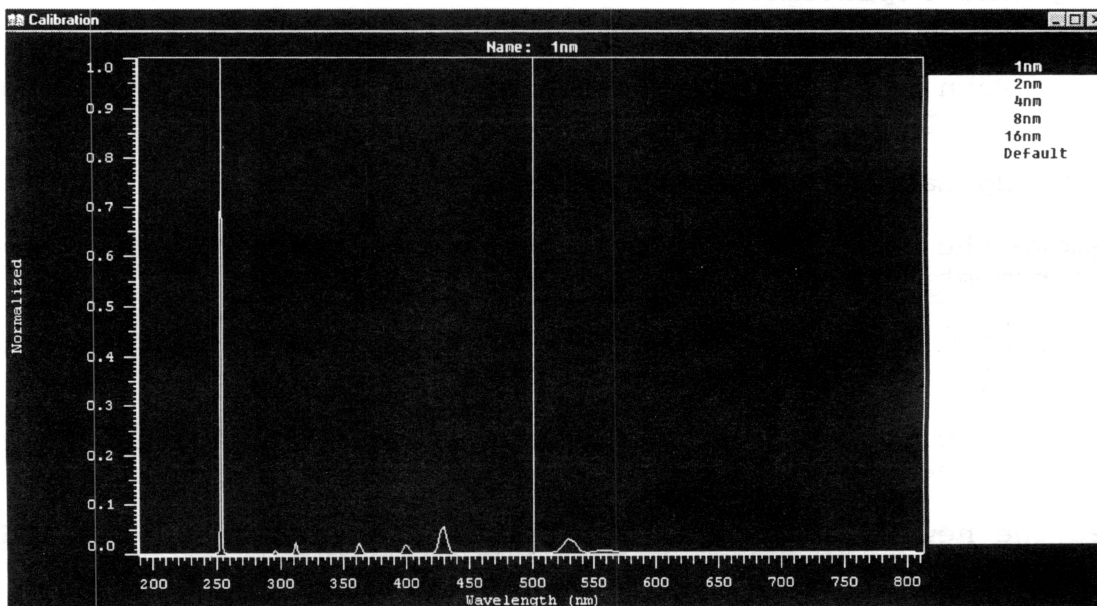
Hg lamp inverter

Step 3: Operation Check

Plug the power cord into a power outlet, and turn on the power switch.

Carry out wavelength calibration with the D-7000 HPLC System Manager, and then check that a sharp spectral peak is indicated in the vicinity of 253.7 nm. (Refer to Appendix 1 - Description of L-7455 DAD Unit Validations - Wavelength Accuracy Check.)

8.3 Hg Lamp Replacement



Step 4: Maintenance Log Setting (Refer to Appendix 1 - Description of L-7455 DAD Unit Validations - D₂ Lamp Replacement Date/Time Input.)
On the main window of the D-7000 HPLC System Manager, select 'Validate DAD' from the 'Maintenance' menu.

Click the **Lamp Maintenance Log** button, enter the date/time of Hg lamp replacement, and press the **Update** button.

8.4 Fuse Replacement

WARNING

Electric Shock in Contact with Inside of Instrument!

In replacement of the fuse, take care not to incur electric shock due to high voltage applied to the power line circuit.
Before removing the fuse, be sure to turn off the power switch and unplug the power cord.

WARNING

Beware of Electric Shock !

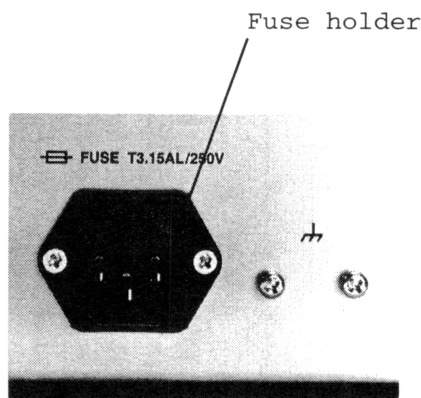
For fuse replacement, make sure to turn OFF the power switch and disconnect the power cord from the instrument.

Step 1: Preparation

Turn off the power switch of this instrument, and unplug the power cord.

Step 2: Fuse Replacement

- 1) Remove the fuse holder while holding its both end sides.



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- 2) Replace the two fuses with new ones on the fuse holder, and attach the holder in place.

APPENDIXES

Appendix 1 Description of L-7455 DAD Unit Validations

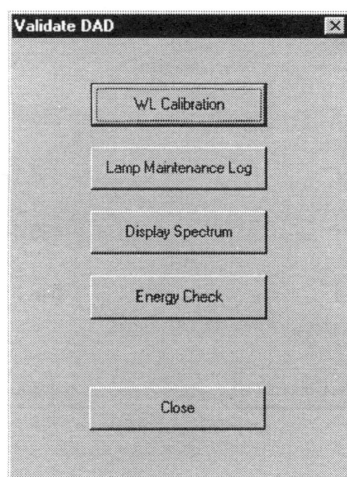
1. Outline

In the L-7455 DAD, the following instrument validation functions are available under control of the D-7000 HPLC system manager.

- Wavelength accuracy check
- Wavelength recalibration
- D₂ lamp energy check
- D₂ lamp/Hg lamp replacement date/time input, and wavelength recalibration date/time correction


2. Validate DAD Window

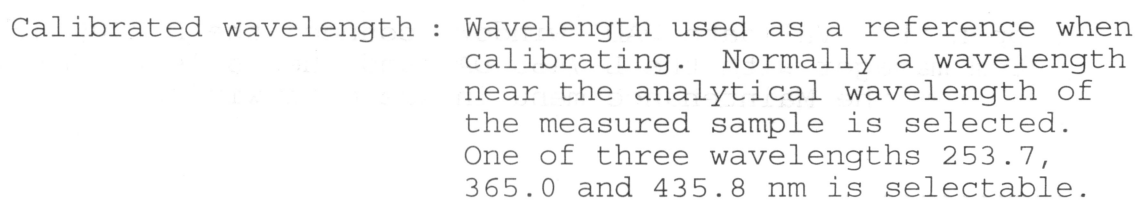
To use each validation function, call up the 'Validate DAD' window of the D-7000 HPLC system manager.



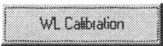
To open the 'Validate DAD' window, connect the D-7000 HPLC system manager with the L-7455 DAD and then select 'Validate DAD' from the Maintenance menu in the main window.

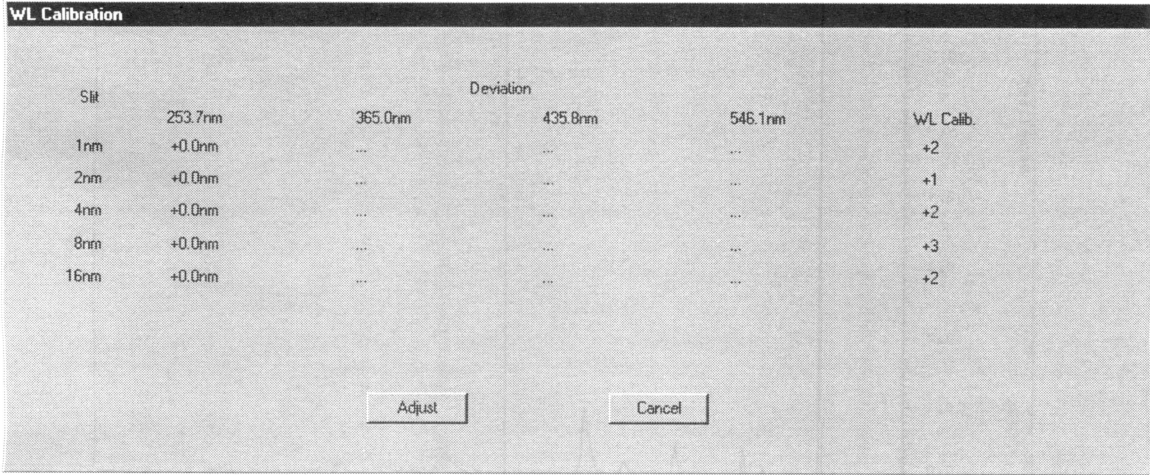



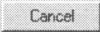
- Click  button and open the "Select Calibration Parameters" window.



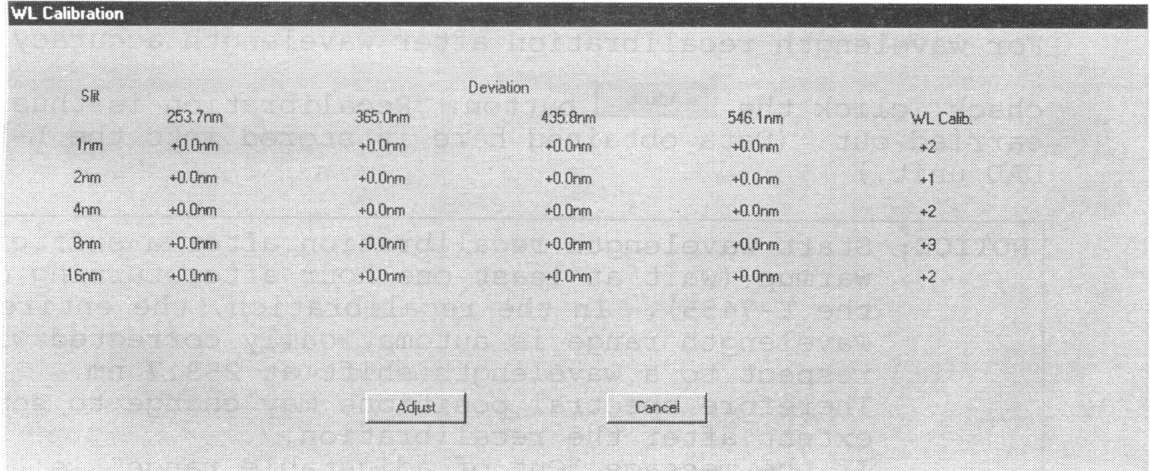
Checked wavelength : Wavelength other than the calibration wavelength that is used for checking. Wavelength deviation is indicated for each selected wavelength. Check wavelength is selectable from 253.7, 365.0, 435.8 and 546.1 nm.

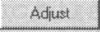
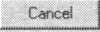
Select "Checked Wavelength" and "Calibrated Wavelength" and click the  button. Then, using the Hg lamp incorporated, wavelength accuracy is checked for each slit (1, 2, 4, 8, 16 nm). The results of this check are indicated as an error with respect to "Checked Wavelength" and "Calibrated Wavelength".

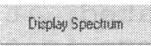


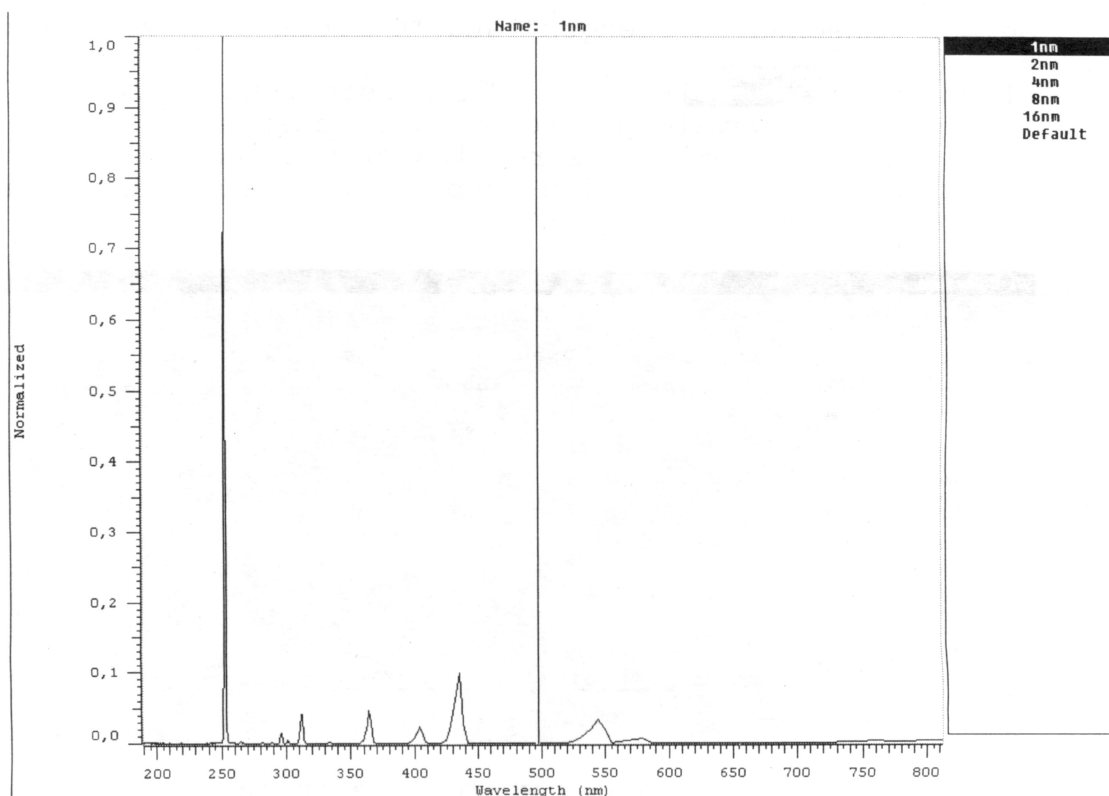
WL Calibration					
Slit	Deviation				WL Calib.
	253.7nm	365.0nm	435.8nm	546.1nm	
1nm	+0.0nm	...	...	...	+2
2nm	+0.0nm	...	...	...	+1
4nm	+0.0nm	...	...	...	+2
8nm	+0.0nm	...	...	...	+3
16nm	+0.0nm	...	...	...	+2
					

Shown below is an example where wavelength accuracy was checked upon selecting all four "Checked Wavelengths".



WL Calibration					
Slit	Deviation				WL Calib.
	253.7nm	365.0nm	435.8nm	546.1nm	
1nm	+0.0nm	+0.0nm	+0.0nm	+0.0nm	+2
2nm	+0.0nm	+0.0nm	+0.0nm	+0.0nm	+1
4nm	+0.0nm	+0.0nm	+0.0nm	+0.0nm	+2
8nm	+0.0nm	+0.0nm	+0.0nm	+0.0nm	+3
16nm	+0.0nm	+0.0nm	+0.0nm	+0.0nm	+2
					

To check Hg lamp spectra at all the slits after wavelength recalibration, click  button in the "Validate DAD" window.



- Wavelength Recalibration

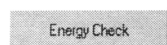
For wavelength recalibration after wavelength accuracy

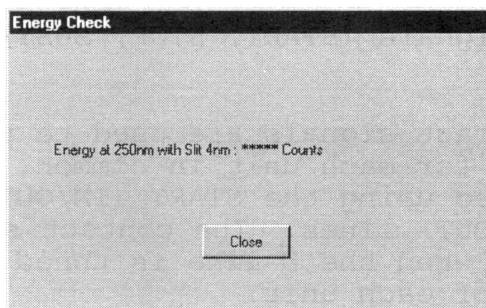
check, click the **Adjust** button. Recalibration is thus carried out. (Data obtained here is stored into the L-7455 DAD unit.)

NOTICE: Start wavelength recalibration after a sufficient warmup (wait at least one hour after turning on the L-7455). In the recalibration, the entire wavelength range is automatically corrected with respect to a wavelength shift at 253.7 nm. Therefore spectral positions may change to some extent after the recalibration. If the message "Out of adjustable range" is indicated in wavelength calibration, carry out wavelength recalibration again. If the same message is indicated, it means that the automatic recalibration range is exceeded. In this case, it is not allowed to perform wavelength recalibration, but measurement can be carried out. Note, however, that measurement is made with wavelength not adjusted.

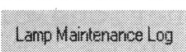
- D₂ Lamp Energy Check

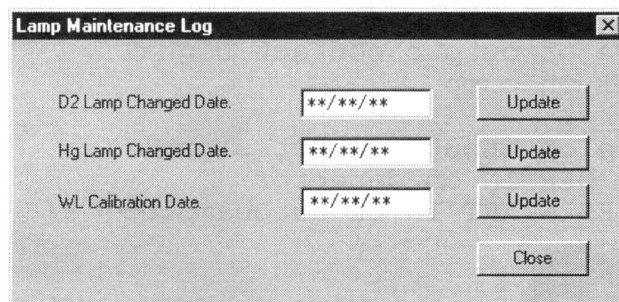
To check energy of the D₂ lamp at a slit of 4 nm, click

 button. An energy value at a wavelength of 250 nm is thus indicated.



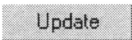
- D₂ Lamp/Hg Lamp Replacement Date/Time Input, and Wavelength Recalibration Date/Time Correction

Click  Lamp Maintenance Log button, and the following dialog box will appear.



D₂ Lamp Changed Date:


After replacing the D₂ lamp, enter the date in this field

and click  button.

(Example: January 24, 1998 → 01/24/98)

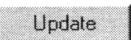
Hg Lamp Changed Date:

After replacing the Hg lamp, enter the date in this field

and click  button.

WL Calibration Date:

When wavelength recalibration is performed, its date is updated automatically. (For correction, enter the date and

click  button.)

Appendix 2 Description of Contact Signals

1. Outline

The following two types of contact signals are used in the L-7000 Series system.

(1) Contact Signals (START, STOP, BUSY) on the D-line Connector

These contact signals are used to provide input/output functions for each unit in common. These signals are transmitted using the START (IN/OUT), STOP (IN/OUT) and BUSY (IN/OUT) lines. The contact signals are made effective when the D-line is tuned off by the setup function of each unit.

(2) Individual Contact Signals on Each Unit

These contact signals are input/output through the 3-pin connectors. The designations and functions of these contact signals are different among units. For each connector, a relevant name representing its function is assigned.

Example of output contact signal:

EVENT on pump

Example of input contact signal:

LAMP OFF IN on detector

SERIES START IN on autosampler

2. Contact Signals on the D-line Connector

Each unit is provided with two D-line connectors on its rear panel (the data processor is provided with one D-line connector). The signals of the two connectors are connected inside mutually. Therefore, by connecting each unit using the D-line cable, the L-7000 Series system can be synchronized with ease. (Refer to Annexed Fig. 1-1.)

For synchronization with the L-6000 Series using the contact signals, use the following cable for contact signal connection.

(1) For START Synchronization Only

Part Number	Part Name	Destination Terminal	Example of Destination Instrument
810-7634	SDIO (START 3P) cable	3P connector	L-6200, D-6100
810-7633	SDIO (START M3) cable	M3 terminal	L-5000
810-7632	SDIO (START M4) cable	M4 terminal	D-2500/2000

(2) For START, READY/BUSY and STOP Synchronization

Part Number	Part Name	Destination Terminal	Example of Destination Instrument
810-7631	SDIO cable	3P connector	L-6200, D-6100

Except where the 3P connector is provided at the destination terminal, it is required to connect a separate cable to the end of the SDIO cable.

- NOTICE:**
1. Be sure to use the cables specified for contact signal connection.
 2. For synchronization with multiple units not included in the L-7000 Series using the contact signals, employ the relay box (P/N 810-7630).
 3. Each contact terminal has polarity. Take care not to mistake its polarity in connection.
 4. A voltage exceeding 30 V should not be applied to across contact terminals.
 5. When contact terminals are short-circuited, a current of 10 mA at maximum is fed per unit. If multiple units are connected using the D-line cable, this current is applied additionally. A contact allowing a current of more than 0.1 A should be provided on the contact start circuit of the destination.
 6. The maximum allowable current to the contact output (start) circuit is 0.1 A. Be sure to check the contact signal receiving circuit of the destination before connection.
 7. A circuit diagram of the D-line contact circuit is shown in Annexed Fig. 1-2. Use it for the purpose of reference.

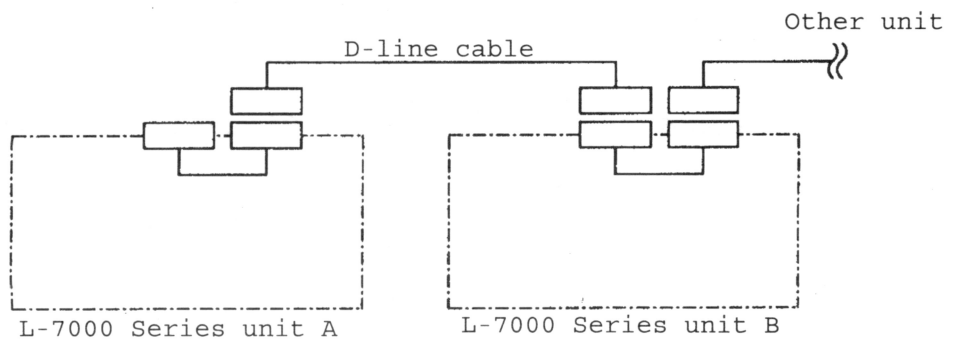
3. Individual Contacts on Each Unit

(1) Contact Input Terminals

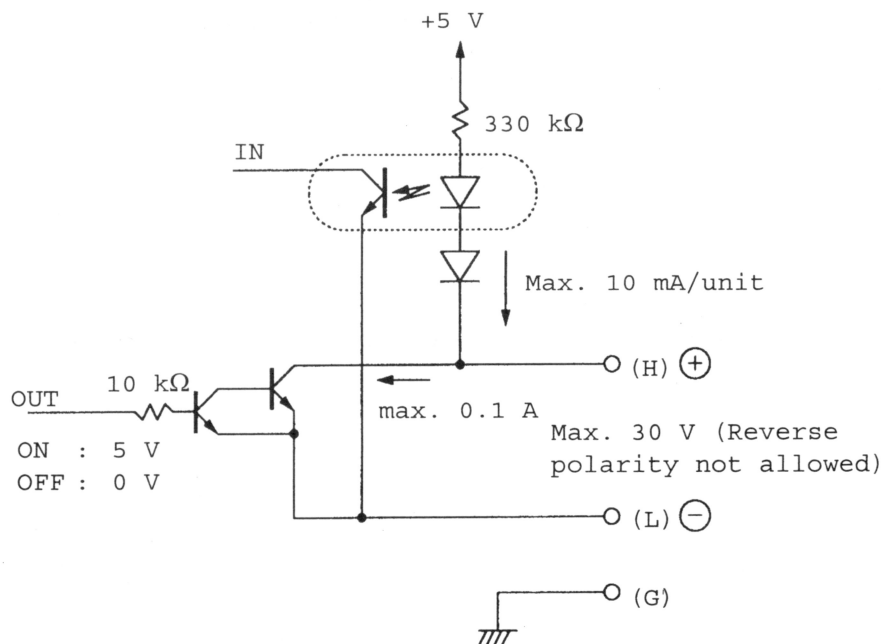
The contact input terminals are used to carry out control according to external switch and relay contact signals. Each contact input signal is made active by shorting the terminals for more than 0.1 second. The input circuit scheme is shown in Annexed Fig. 1-3.

(2) Contact Signal Output Terminals

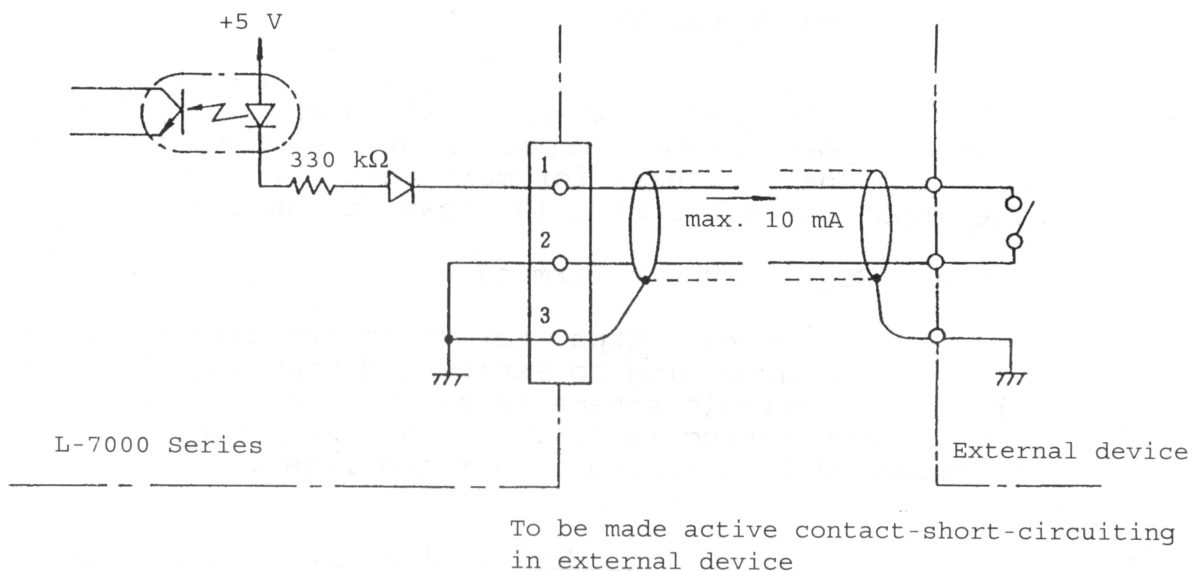
The contact signal output terminals are used to carry out control according to external device contact signals. The output circuit scheme is shown in Annexed Fig. 1-4. The contact rating is 30 V, 0.1 A. Take care not to let a connected load exceed this rated level.



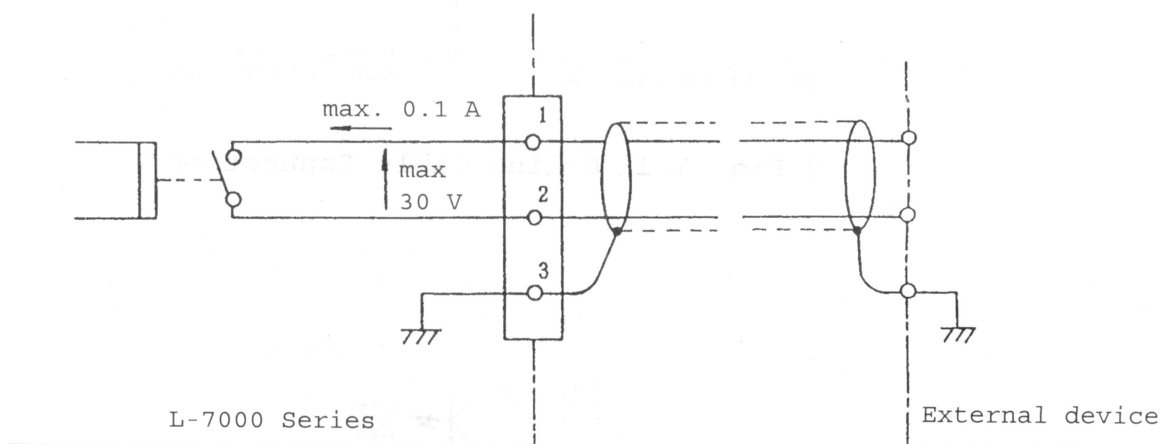
Annexed Fig. 1-1 D-line Cable Connection



Annexed Fig. 1-2 D-line Contact Circuit Scheme



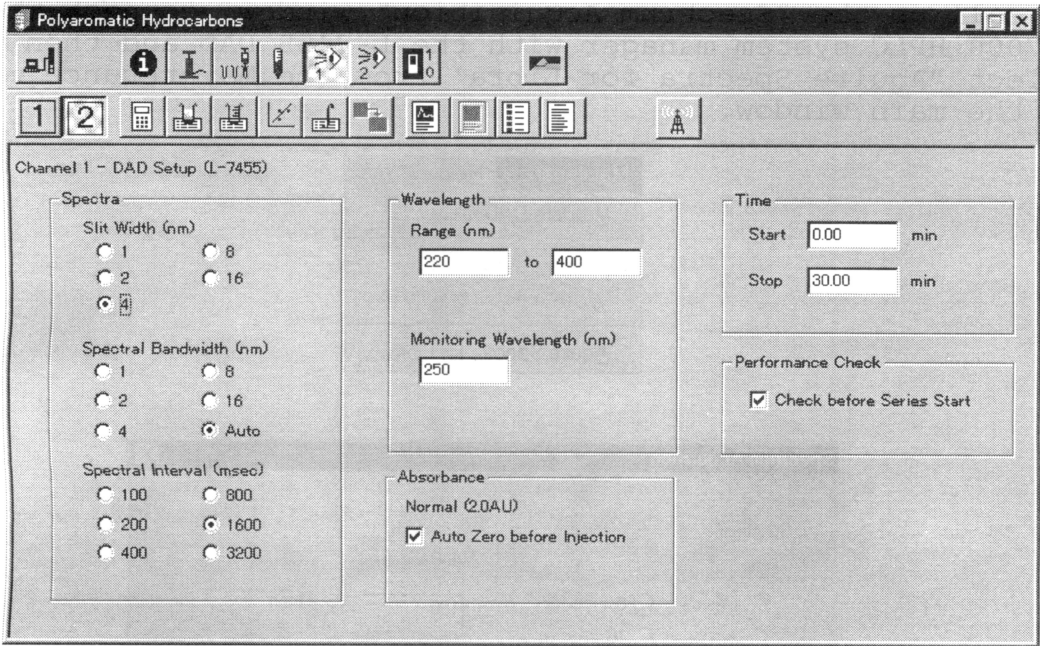
Annexed Fig. 1-3 Contact Signal Input Circuit



Annexed Fig. 1-4 Contact Signal Output Circuit

Appendix 3 Addition of L-7455 DAD Control Mode

For increasing the operation speed of the D-7000 HSM with the L-7455 connected (start of monitoring/measurement), the operability-preference mode is available (From Revision 25 of Model D-7000 HPLC System Manager, and Revision 16 of Model Multi System Manager.) In the analysis method function, the user can select the operability-preference mode (without WL check and energy check) in which the operation speed at the start of measurement takes precedence over confidence information processing.



By default, it is assumed that the WL check and energy check are to be performed.

NOTE:

- Auto Zero is not performed at beginning an Idle Monitor without checking Auto Zero before Injection.
- In confidence reporting, module performance test data measured in the operability-preference mode (without WL check and energy check; priority given to operation speed at start of measurement) is output as demonstrated below.

D₂ lamp energy at 250 nm : 99999
WL difference value (nm) : +98.0
Wavelength accuracy : Not measured

WARNING: D₂ lamp energy of L-7455 is not measured.

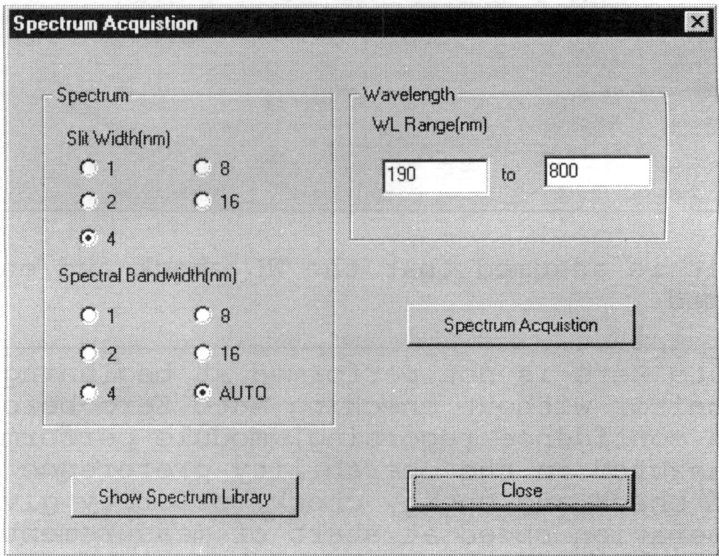
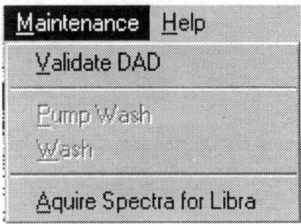
Appendix 4 Description of Library Spectrum Acquisition

1. Outline

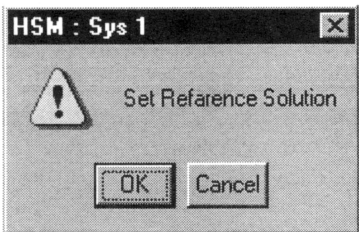
In the L-7455 DAD, the library spectrum acquisition function with the cuvette holder (P/N:810-2895, option) is available using a 10 mm rectangular cell for spectrophotometer (it is compatible with version 4.0 upward of the D-7000 HPLC System Manager).

2. Spectrum Acquisition Window

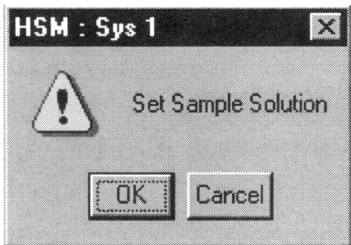
To call up the "Spectrum Acquisition" window, connect the D-7000 HPLC system manager with the L-7455 DAD and then select "Aquire Spectra for Libra" from the Maintenance menu in the main window.



Select a Slit Width, Spectral Bandwidth and WL Range and click the **Spectrum Acquisition** button.

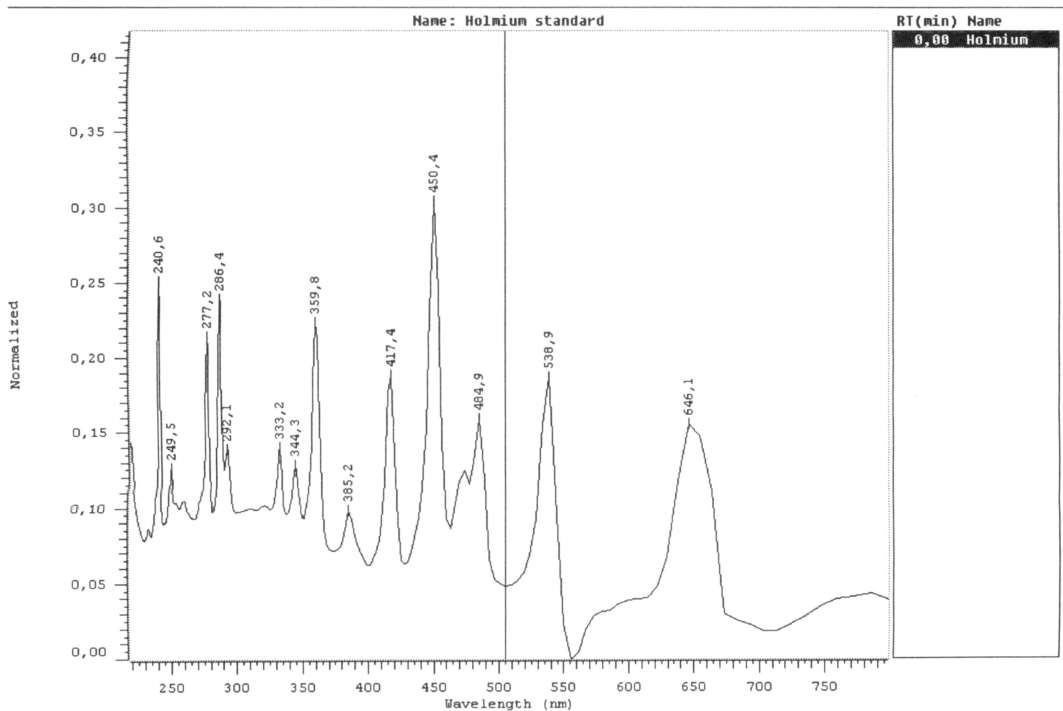
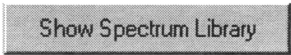


Set a reference solution and click the **OK** button.



Set a sample solution and click the **OK** button.

To check the spectra after acquisition, click **Show Spectrum Library** button in the "Spectrum Acquisition" window.



GLOSSARY

HPLC system manager	: Software for carrying out control of the entire HPLC system, data acquisition, data analysis and management.
Slit	: An optical element which allows light to pass through a limited opening.
Diode array detector (DAD)	: An HPLC detector equipped with a photodiode array for detection.
Download	: To transmit parameters and other data from an upper-rank control instrument (HPLC manager) through communication.
Default	: Initial setting in which no change is made.
D ₂ lamp	: A deuterium discharge lamp used as a light source.
D-line	: A digital network dedicated for analytical operation.
Photodiode array (PDA)	: A detector having an array of semiconductor photodetecting elements.
Prism	: An optical glass element having a triangular shape for dispersing light according to wavelengths.
Flow cell	: A sample cell for continuous measurement.
Lamp chamber	: A part for housing a lamp. When the instrument is used, the lamp chamber becomes hot. Take care not to incur burns by touching it.
GPIB	: A digital bus which is widely used for connecting a computers with various measurement instruments for control.

- Shutter mirror : For auto zero, this shutter mirror cuts off a beam from the light source. In WL calibration, it cuts off a beam from the light source lamp and reflects a beam from the Hg lamp to the detector.
- WL calibration : For wavelength accuracy check.
- Hg lamp : A mercury discharge lamp used for WL calibration.
- Validation : For checking that the instrument performs its operation properly as required.

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STANDARD OPERATING PROCEDURE (SOP)

Title : Test function and specification
for the L-7455 DAD.

Valid since : 1 May 1998

This SOP replaces the version of : New version, issue 1

Policy : Establish functional
reliability of the instrument.

Responsibility : Head of Laboratory

	Data/Signature	Copy received by:
Written	:	Head of Testing Facility Head of Laboratory Laboratory Personnel GLP Department

Reviewed :

Approved :

Total number of pages :

References:

- L-7455 Diode Array Detector (DAD) Installation and Maintenance Manual
- D-7000 HPLC System Manager User's Manual

Items Checked

1. Function
2. D₂ Lamp Energy
3. Wavelength Accuracy
4. Baseline Noise Level
5. Baseline Drift

Initial Requirements

1. Pure water (ion-exchanged or distilled), 100 mL
2. Injection syringe
3. Calipers
4. PC with D-7000 HPLC System Manager (HSM) software and National Instruments (NI) AT-GPIB/TNT circuit board and driver software
5. Printer

L-7455 DAD Setup


1. Install the L-7455 in an environment where temperature variance remains within $\pm 1.0^{\circ}\text{C}$.
2. Install cable between the L-7455 DAD and the GPIB connector on the PC.
3. Turn power on to the L-7455 DAD and allow the unit to warm up for approximately 60 minutes.
4. Connect the syringe to the inlet tube of the L-7455 DAD and fill the flow cell with pure water.

1. Function Check

Purpose

Prove that self diagnosis tests were successfully completed after power to the L-7455 DAD is turned on and the program is downloaded from the PC.

Procedure

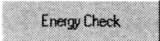
1. Turn on power to the L-7455 DAD and check that the **Power** and **Lamp** Indicators light.
2. Start the D-7000 HSM program on the PC.
3. Click on  to open the **Hardware Status** dialog.
4. Click on the **Initialize** button and wait approximately 1 minute. (In the previous version of the D-7000 HSM you do not need to click this button.) Then, check that L-7455 appears in the **Detectors** : display box.

2. D₂ Lamp Energy Check

Purpose

Check D₂ lamp energy at a wavelength of 250 nm with 4 nm slit selected.

Procedure

1. On the main window of D-7000 HPLC System Manager, open the 'Validate DAD' window and then click the  button.
2. Check D₂ Lamp Energy.

Specifications

More than 20,000 or, as an alternative, observe the following:

Lamp energy value should be greater than half of the initial lamp energy value.

where the initial lamp energy is the value obtained after lamp was used for 10 to 15 hours. If you use this specification, you should record the initial lamp energy value on the test report.

Note: D₂ Lamp energy is decreased by the following:

1. Lamp, mirror, prism, or flow cell is not correctly mounted.
2. Bubbles, foreign matter, or stains remain in the flow cell.

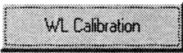

If the mirror or grating is not correctly mounted, contact the closest service center.

3. Wavelength Accuracy Check

Purpose

Check wavelength accuracy with reference to an emission line of Hg lamp at a wavelength of 253.7 nm.

Procedure

1. On the main window of D-7000 HPLC System Manager, open the 'Validate DAD' window and then click the  button.
2. Check wavelength accuracy for each slit. If wavelength recalibration is required, click the  button.
 - Checked by:
 - Checked Date:
 - WL Accuracy (1 nm) :
 - (2 nm) :
 - (4 nm) :
 - (8 nm) :
 - (16 nm) :
 - Adjustment: Performed, Not performed

Specification

253.7 ± 2 nm

4. Noise Level Check

Purpose

Check Baseline Noise Level.

Procedure

1. Using the D-7000 HSM program, acquire data for 15 minutes and print a chromatogram report of the data. (Refer to the D-7000 HPLC System Manager User's Manual.)
2. Change default settings in the new Method to the following:

Channel 1 - DAD Setup

Slit width : 4 nm
Spectrum Bandwidth : 4 nm
Spectrum Interval : 1600 msec
Stop Time (min) : 15.00

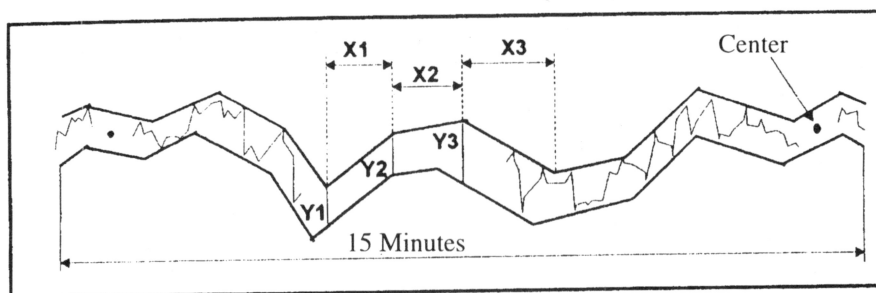
Channel 1 - DAD Data Processing

Integrated Chromatogram 240 to 260 nm

Channel 1 - Chromatogram Display format

Intensity Range : Autoscale
Horizontal Axis Scale : Full Scale

3. Calculate Noise Level by the following:



$$\text{Noise Level} = \sum_{R=1}^{R=n} Y_R / n \quad (X_n = 0.5 \text{ min})$$

NOTE: This test should be performed at least 1 hour after the L-7455 DAD is turned on.

Specification

Less than 0.0001 AU

5. Drift Level Check

Purpose

Check Baseline Drift Level.

Procedure

1. Using the D-7000 HSM program, acquire data for 60 minutes and print a chromatogram report of the data. (Refer to the D-7000 HPLC System Manager User's Manual.)
2. Change default settings in the new Method to the following:

Channel 1 - DAD Setup

Slit Width	: 4 nm
Spectrum Bandwidth	: 4 nm
Spectrum Interval	: 1600 msec
Stop Time (min)	: 60.00

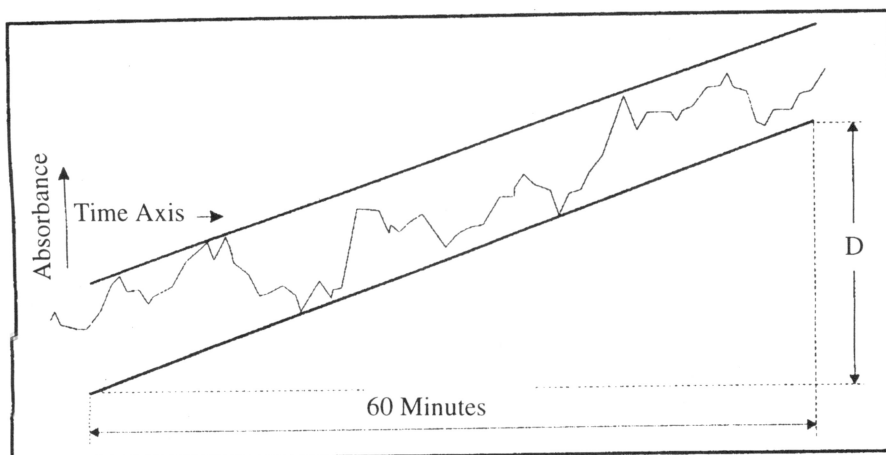
Channel 1 - DAD Data Processing

Integrated Chromatogram 240 to 260 nm

Channel 1 - Chromatogram Display format

Intensity Range	: Autoscale
Horizontal Axis Scale	: Full Scale

3. Calculate Drift Level by the following:



NOTE: This test should be performed at least 1 hour later after the L-7455 DAD is turned on.

Specification

Less than 0.006 AU/hr.

Module	Diode Array Detector
Model	L-7455
Instrument Number	

NO.	Item Tested	Specification	Result	Tester
1	Function			
	Power Lamp	Lamp lights		
	D ₂ Lamp	Lamp lights		
	GPIB Communication	Program downloading completed		
2	D ₂ Lamp Energy	More than 20,000		
3	WL Accuracy	253.7 ± 2 nm		
4	Noise Level	Less than 0.0001 (AU)		
5	Drift Level	Less than 0.006 (AU/hr)		

Tested on:
 Next Test scheduled for:
 Tested by: